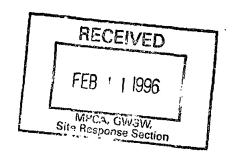
SOIL INVESTIGATION REPORT

Ground Water & Solid Waste Division Site Response Section
Site Name
Category
S ¹ cotagory
Init:als



SOIL INVESTIGATION REPORT

SUBMITTED TO THE

REGIONAL ADMINISTRATOR UNITED STATES ENVIRONMENTAL PROTECTION AGENCY REGION V

EXECUTIVE DIRECTOR
MINNESOTA POLLUTION CONTROL AGENCY

BY

THE CITY OF ST. LOUIS PARK, MINNESOTA

PURSUANT TO
CONSENT DECREE-REMEDIAL ACTION PLAN
SECTION 11.1.3

UNITED STATES OF AMERICA, ET AL.

vs.

REILLY TAR AND CHEMICAL CORPORATION, ET AL.

UNITED STATES DISTRICT COURT
DISTRICT OF MINNESOTA
CIVIL NO. 4-80-469

SUBMITTED JANUARY 13, 1989

AMENDED APRIL 18, 1989

TABLE OF CONTENTS

		•	Page
1.0	INTRO	DDUCTION	1
	1.2	Background Purpose Approach	1 1 2
2.0	SITE	DESCRIPTION	3
		Location Site Hydrogeology	3 3
3.0	FIELI	O PROGRAM	6
	3.2	General Drilling Procedures Soil Sampling Procedures	6 6 6
4.0	ANALY	TICAL PROGRAM	9
		Parameters Results	9 9
5.0	DISCU	JSSION	12
	5.2 5.3	General Interpretations of Analytical Results 5.2.1 Benzene Extractable Compounds 5.2.2 Phenolic Compounds Probable Surface Flow Pathways Relative Hazard of Remaining Soils	12 12 12 14 14 15
6.0	CONCI	LUSIONS	16
		Project Summary Summary of Results Need for Further Work	16 16 17
APP	ENDIC	ES A MAP B BORING LOGS C QUALITY ASSURANCE PROJECT PLAN D ANALYTICAL RESULTS E PART O CORRESPONDENCE F DRILLER'S REPORT	

LIST OF TABLES

	Page
2-1 WATER LEVEL DATA	4
4-1 SOIL ANALYTICAL RESULTS SUMMARY	10
5-1 BACKGROUND CONTAMINANT CONCENTRATIONS FOR VARIOUS MATERIALS	13

1.0 INTRODUCTION

1.1 Background

This report presents the results of the investigation of near surface soil contamination in an area of St. Louis Park, Minnesota, south of the former Reilly Industries, Inc. (Reilly) site. The City of St. Louis Park (City) conducted the soil investigation pursuant to Section 11 of the Consent Decree-Remedial Action Plan (CD-RAP) in the case of the United States of America, et al., vs. Reilly Tar and Chemical Corporation, et al. The City submitted a Soil Investigation Plan to the Minnesota Pollution Control Agency (MPCA) and the United States Environmental Protection Agency (U.S. EPA) on December 3, 1986. The City filed amendments to the plan on December 31, 1986, October 28, 1987, July 8, 1988, September 23, 1988, and November 17, 1988. Upon receipt of verbal approval of the Soil Investigation Plan from the MPCA and U.S. EPA, the City conducted the field program in September, 1988.

1.2 Purpose

The purpose of this report is to provide the MPCA and U.S. EPA the results of laboratory analyses and visual and olfactory observations completed on samples taken from 15 shallow borings in an area bounded by Lake Street on the north; Monitor Street and an imaginary straight-line extension of Monitor Street to Methodist Hospital on the east; Minnehaha Creek on the south; and Taft Avenue and an imaginary straight-line extension of Taft Avenue to Minnehaha Creek on the west (see Appendix A). The results of laboratory analyses and visual and olfactory observations will serve to determine those properties owned by the parties to the CD-RAP on which a release of hazardous substances resulting from operations at the former Reilly site

has occurred or is occurring. Further, those results will serve to identify other properties within the area described above, on or under which a release has occurred or is continuing to occur.

1.3 Approach

Upon receipt of verbal approval of the Soil Investigation Plan, a licensed contractor installed fifteen borings in locations designed to cover the entire study area. Seven borings were located on property owned by the City and eight borings were located on private property pursuant to the receipt of the owners' permission. All borings were located outdoors.

Soil samples were collected for analysis for benzene - extractable compounds and phenolic compounds in accordance with the provisions of the Soil Investigation Plan, and qualitative descriptions of contamination were carefully recorded for each soil sample. A set of ten samples qualitatively described as clean was collected for analysis to help determine background levels of benzene extractables and phenolics. The results of the soil investigation are based on both qualitative descriptions and quantitative data.

2.0 SITE DESCRIPTION

2.1 Site Location

As described above, the boundaries of the site are as follows: Lake Street on the north; Monitor Street and an imaginary straight-line extension of Monitor Street to Methodist Hospital on the east; Minnehaha Creek on the south; and Taft Avenue plus an imaginary straight-line extension of Taft Avenue to Minnehaha Creek on the west (Appendix A). Most of the site is paved or impermeable, and is occupied primarily by commercial and light industrial facilities.

2.2 Site Hydrogeology

In the study area, approximately 65 feet of Drift and 25 feet of Platteville Limestone overlie the Glenwood Shale confining bed. The Drift consists of sands and gravel which are in some places overlain by lacustrine deposits (e.g., peat and organic clay in the bog area south of the former Reilly site) and underlain by till, outwash, valley-fill deposits and weathered bedrock (U.S. Geological Survey Water Supply Paper 2211).

Historically, ground water flow in the Drift Aquifer has been to the east-southeast (U.S. Geological Survey Water Supply Paper 2211). This flow direction, coupled with the known sources of ground water contamination in the bog area north of Lake Street (a hydrogeologic recharge zone adjacent to the study area), has resulted in ground water contamination in part of the northern portion of the CD-RAP Section 11 Soil Investigation study area. This contamination has been noted at dewatering activities for construction projects at South Oak Pond and at the Costco property (3745 Louisiana Avenue).

TABLE 2-1
WATER LEVEL DATA

Boring	Surface <u>Elevation</u>	<u>Depth</u>	<u>Elevation</u>
Bl	894.1	12.5	881.6
B2	890.3	13.6	876.7
В3	889.2	7.3	882.0
B4	889.9	NA	NA
B5	892.0	12.2	879.8
B-6b	888.4	3.3	885.1
B-7	890.7	6.8	883.9
B-8	890.6	7.8	882.8
B-9	889.2	3.2	886.0
BlO	891.6	8.2	883.4
B11	890.6	12.2	878.4
B12	893.3	16.2	877.1
B13	890.4	6.5	883.9
B14	892.4	10.1	882.3
B15	894.1	NA	NA

NA indicates not available

Water levels taken in the boreholes immediately upon completion (Table 2-1) indicate general eastward ground water flow. However during the Soil Investigation, the South Oak Pond dewatering activities were ongoing, and probably influenced the measured water levels. This is indicated in the data by a subdued apparent ground water divide, with a steeper gradient on the east side (the regional flow direction) and a shallower gradient on the west side (due to the dewatering activities).

3.0 FIELD PROGRAM

3.1 General

The field program consisting of fifteen soil borings in the locations shown on the site map (Appendix A) was conducted between September 6, 1988 and September 23, 1988. The borings ranged in depth from 36.0 to 55.5 feet below ground surface, none penetrating bedrock.

3.2 Drilling Procedures

A licenced water well contractor performed the drilling activities and sample retrieval in accordance with provisions of the approved Soil Investigation Plan. minimize cross contamination, the contractor steam cleaned the drilling rig and all sampling and drilling tools prior to beginning the work and between boring locations. The drilling contractor advanced the boreholes using a truck-mounted auger rotary drilling rig with continuous hollow stem flight augers. The addition of drilling fluids was allowed below ground water depth, when necessary. Upon completion, the contractor completely grouted all boreholes from the bottom upwards with a bentonite-cement mixture using a tremie pipe, according to the Minnesota Water Well Construction Code. The contractor containerized all wash water, drilling cuttings and fluids for later disposal by the City.

3.3 Soil Sampling Procedures

Prior to sampling and between sample points, the contractor steam cleaned the sampler and rinsed it with methanol, hexane, methanol, and deionized water. If no contamination was noted in the sample, steam cleaning was eliminated from the sequence.

Dedicated latex sampling gloves were used. The geologist collected samples from the unsaturated zone with split-spoon samplers, driven in advance of the auger into undisturbed soils by dropping a 140-pound hammer 30 inches onto the drilling rods. Samples from the saturated zone were collected in a similar fashion, except that the sampler was first wrapped in plastic, then driven into undisturbed soils in advance of the auger. The plastic wrapping around the sampler assured the integrity of the samples in the saturated zone, where the use of drilling mud was necessary.

All samples weighed at least 200 grams, and were placed in 500 ml widemouth glass jars fitted with aluminum foil-lined caps. The field geologist classified the soil types and preserved their integrity, avoiding the mixing of soil types within a sample.

Duplicate samples were collected at the rate of 1 in 20, by splitting the core lengthwise. All samples were immediately chilled to 4 degrees centigrade, according to the Quality Assurance Project Plan (Appendix C). Proper chain-of-custody procedures were followed.

The environmental geologist recorded sampling procedures and observations, including HNu measurements and visual or olfactory evidence of contamination on the appropriate boring logs (Appendix B). Based on visual or olfactory evidence of contamination, the geologist classified each borehole with the following terms, as defined at Borings B-2 and B-3: "slight" creosote contamination; and "mild" creosote The twenty-five samples were sent to the contamination. laboratory for analysis based on the following criteria: at least one sample from each boring was analyzed; and 2) the judging obviously contaminated samples, HNu measurements and visual or olfactory observations, analyzed. In addition, to characterize background levels of

phenolics and benzene-extractable compounds, ten samples classified by olfactory observation as "clean" were sent for analysis; of these, four were peat samples.

4.0 ANALYTICAL PROGRAM

4.1 Parameters

Section 11 of the CD-RAP requires that at least 15 but no more than 45 soil samples be analyzed for benzene - extractable and/or phenolics compounds. In this laboratory analytical program, maximum information concerning possible contaminants in the soil was provided by analyzing twenty-five soil samples from fifteen borings for both parameters. The laboratory used EPA Test Method SW-846 (3rd edition), Method 9071 for benzene - extractable compounds, and EPA Test Method SW-846 (3rd edition), Method 9065 for phenolics compounds. The details of the analytical procedure are included in the Quality Assurance Project Plan (Appendix C).

4.2 Results

The laboratory analytical results are included as Appendix D, and are summarized in Table 4-1. The benzene-extractable compound concentrations in these samples ranged from below the detection limit (BDL; less than 50 ppm) to 14,000 ppm, with typical concentrations in the range of 50 - 500 ppm. Nearly half (11) the samples had concentrations less than 100 ppm, and nine others had concentrations between 100 and 1000 ppm. The phenolic compound concentrations range from BDL (less than 0.2 ppm) to 0.50 ppm, with 20 of the samples below the detection limit. Three samples from borings B-2, B-3, and B-14 have phenolic compound concentrations slightly greater than the detection limit, with respective concentrations of 0.26 ppm, 0.22 ppm, and 0.24 ppm.

A discussion of the laboratory analytical results is included in Section 5.2.

TABLE 4-1 SOIL ANALYTICAL RESULTS SUMMARY

Results (mg/kg)	<pre><pre>< 0.2 < 0.2 < 0.2 </pre></pre>	0.26	0.22	<pre></pre>	<0.2	<0.2 <0.2	<0.2	<0.2	<0.2 <0.2
Analytical Re Benzene- Extractable Compounds	420 80 50	170	2,300	14,000 6,000 220	150	940 80	130	<50	, <50 110
Visual/ Olfactory <u>Analysis</u>	Clean	$Mild^2$	slight ²	Clean	Clean	Clean	Clean	Clean	Clean
<u> </u>	D & &	Ø	ഗ	១ ខ ខ	Ø	ល ល	Ø	w	യ യ
Depth(ft)	9.5-11 20-21.5 25-26.5	20-21.5	19.5-21	4.5-6 9.5-11 14.5-16	29.5-31	14.5-16 24.5-26	24.5-26	24.5-26	4.5-6 34.5-36
Material	Silt Clay Sand	Sand	Sand	Peat Peat Silt	Sand	Silt Gravel	clay	Gravel	Silt
Sample #	83 85	ន	នទ	88 88 84 84 84 84 84 84 84 84 84 84 84 8	S7	S 4 S 6	S6	86	S2 S8
Boring	B1	B2	. ВЗ	B4	в5	вер	B7	B8	B9

TABLE 4-1 (con't)
SOIL ANALYTICAL RESULTS SUMMARY

:

Analytical Results(mg/kg) Visual Benzene- Olfactory Extractable Compounds Phenolics	0.38	<0.2	<0.2 <0.2	0.50	0.24	<0.2 <0.2
Analytical Visual Olfactory Compounds	<50	<50	<50 130	1,800 2,100	<50 200	<50 <50
Analysis	Clean	Clean	Clean	Clean	Clean	Clean
1 <u>87n</u>	, M	n	១ន	ខ្មា	ထ ထ	တ တ
Depth(ft) U/Sl	24.5-26	9.5-11	9.5-11 29.5-31	4.5-6 9.5-11	19.5-21 49.5-51	14.5-16 24.5-26
Material	Sand	Gravel	Clay Sand	Peat Peat	Sand Sand	Sand Clay
Sample # Mater	S	83	S3 S7	S2 S3	S5 S11	84 86*
Boring	B10	B11	B12	813 11	B14	B15

^{*}Duplicates taken here

0

U indicates unsaturated sample S indicates saturated sample Denotes "mild" or "slight" creosote contamination

5.0 DISCUSSION

5.1 General

The purpose of this section is to interpret and discuss the analytical results, discuss probable surface flow pathways, and consider the relative hazard of remaining soils.

5.2 Interpretations of Analytical Results

Interpretation of the analytical results is guided by an understanding of background benzene-extractable and phenolics compound concentrations in soils beneath the study area. Although the Soil Investigation Plan called for the analysis of ten samples qualitatively classified as clean, in fact, 23 of the samples collected were from soils classified on-site as clean. Contaminant concentrations in these samples apparently represent background contaminant concentrations, based on qualitative descriptions of the samples, and on historic benzene-extractable and phenolic compound concentrations measured in area soils, as described in the Soil Investigation Plan. Table 5-1 summarizes the ranges of background contaminant concentrations for saturated and unsaturated sands, gravels, silts, clays, and peats.

5.2.1 Benzene Extractable Compounds. Samples collected from the two boreholes bearing visual or olfactory evidence of creosote contamination were saturated sands (Table 4-1). The sample from boring B-2, classified as mildly contaminated, had a concentration of 170 ppm, well within the limits of background concentrations as shown on Table 5-1. The sample from boring B-3, classified as slightly contaminated, had a concentration of 2,300 ppm, a high value for a sand sample. Since these samples are from the saturated zone and ground

TABLE 5-1

BACKGROUND CONTAMINANT CONCENTRATIONS

FOR VARIOUS MATERIALS

	Backgro	ound Concent	<u> rations (mg/</u>	kg)
	Benzene-extra	actables	Pheno	lics
<u>Material</u>	Unsaturated S	Saturated	Unsaturated	Saturated
Peat	1,800-14,00	2,100-6	5,000 <0.2-0	.5 <0.2
Sand		<50-200)	<0.2-0.38
Gravel	<50	<50-80	<0.2	<0.2
silt	. 420	<50-940	<0.2	<0.2
Clay	<50	<50-130	<0.2	<0.2

water is known to be contaminated in the vicinity of these borings, contaminated ground water may have influenced the qualitative classifications of the saturated soil samples.

5.2.2 Phenolics Compounds. The highest phenolics compound concentrations (0.38 ppm and 0.50 ppm) were identified in borings B-10 and B-13, though the values do not represent significantly high concentrations. Furthermore, borings B-10 and B-13 are located relatively far from contaminant source areas in the bog, and the slightly elevated phenolic compound concentrations thus probably represent variations in cultural or man-made background concentrations.

5.3 Probable Surface Flow Pathways

Historical aerial photographs (1940, 1945, 1953, 1957, 1964, 1969) and the U.S. Geological Survey 7.5 minute topographic map of the area show the general surface gradient from the site is south, toward Minnehaha Creek. However, the photographs and map show no obvious past or present surface water drainage route from the site directly to Minnehaha Creek. This is true for each year for which aerial photography was reviewed including early years when the land area was largely undeveloped, and later years when urban development encroached upon the bog.

It seems likely that surface drainage ran off the site to the bog area directly south of the site (bounded by Walker and Lake Streets, bisected by Highway 7), but that no surface drainage outlet from this area existed. Surface drainage was bounded to the east by the berm created by the Prest-O-Lite Company's lime lagoons (now the Wholesale Warehouse Club's parking lot - 3745 Louisiana Avenue). Surface drainage may have followed the present course of Louisiana Avenue, as six borings taken in 1979 along its southerly extension between

West Lake Street and the railroad embankment to the south were qualitatively described as contaminated and/or contained elevated concentrations of phenolics and/or extractables (refer to page 7 of the Site Management Plan contained in the Soil Investigation Plan issued pursuant to Section 11.1.1 of the CD-RAP). However, the railroad embankment (south of Prest-O-Lite) prevented further southward surface water movement. Instead, the surface water (and the contaminants it carried) entered the ground water system by moving downward within the bog area, which is a hydrogeologic recharge zone.

5.4 Relative Hazard of Remaining Soils

The boring locations in this project have covered a wide area south of the former Reilly site, ranging from 500 to 2500 feet downgradient from the site. The analytical results show low contaminant concentrations in soils collected from these borings. Furthermore, visual and olfactory observation of the soils indicated all but two borings were situated in apparently clean soils. The study area is currently occupied by commercial, light industrial or other non-residential uses. Therefore the relative hazard associated with the remaining soils in the project area is judged to be low.

6.0 CONCLUSIONS

6.1 Project Summary

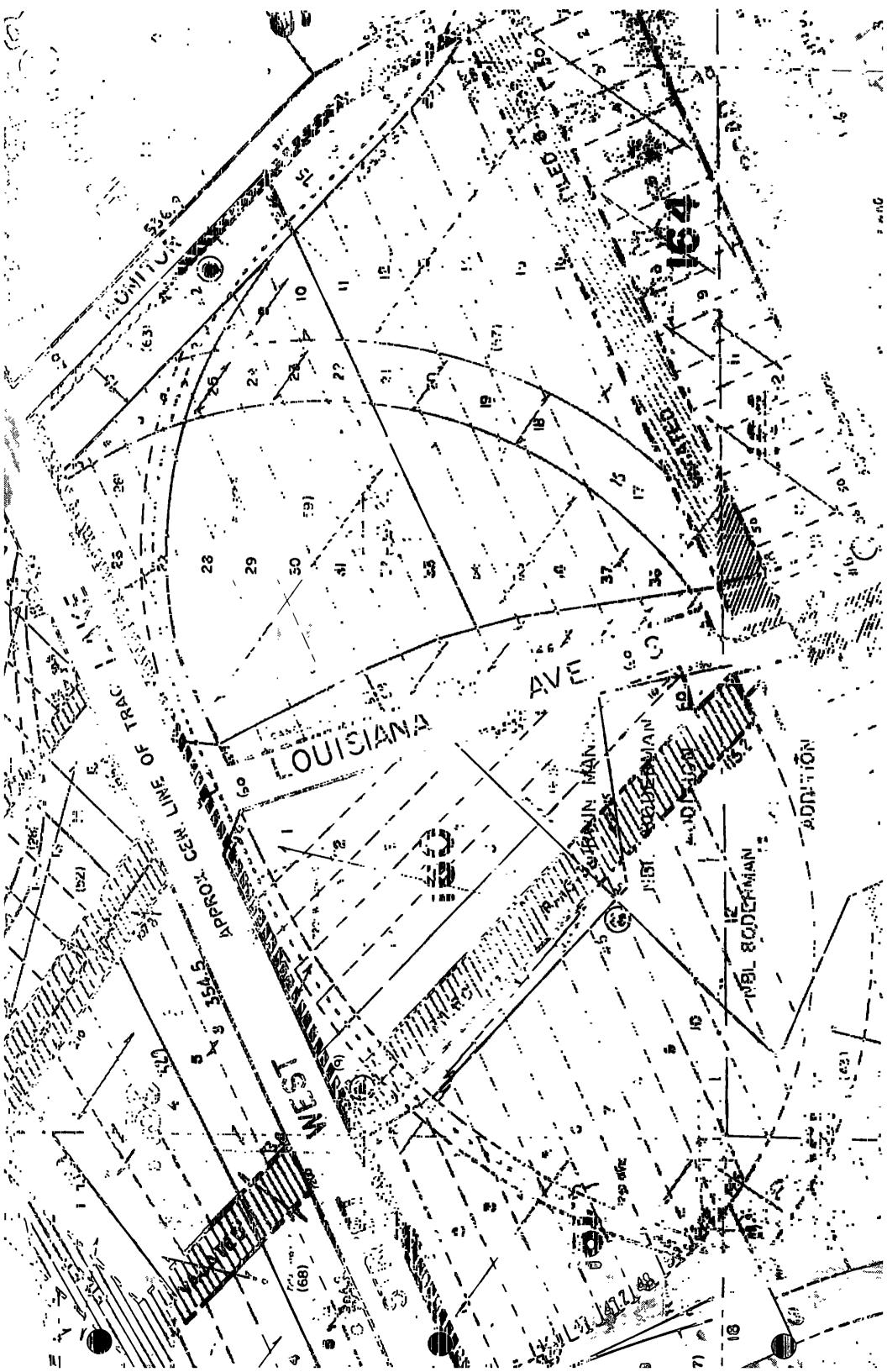
In accordance with the Soil Investigation Plan, fifteen soil borings were installed in an area south of the Reilly site bordered by Lake Street, Monitor Street, Minnehaha Creek, and Taft Avenue in St. Louis Park. Split spoon sampling of these soils at 5 foot intervals to a minimum depth of 35 feet for each boring produced samples suitable for field evaluation and laboratory analysis. Samples were selected for analysis of phenolic and benzene-extractable compound concentrations based on visual/olfactory observation and HNu field-screening.

6.2 Summary of Results

Field observation and classification of soils identified 13 clean boring locations. Soil samples from the remaining two borings had visual or olfactory evidence of creosote contamination. Laboratory results provided an indication of the wide range of natural and man-made background contaminant concentrations for the various materials collected from the clean boreholes. Boring B-2 showed evidence of contamination and had contaminant concentrations within the limits defined for background. Boring B-3 had concentrations within likely background limits. Contaminated ground water in the vicinity influenced the qualitative field descriptions in saturated soil samples.

6.3 Need for Further Work

The soils in the area designated by Section 11 of the CD-RAP have been found to be relatively free of hazards. MPCA personnel agreed with this assessment and have confirmed that the City may forego the installation of the ten optional soil borings at this time (see Appendix E). Therefore, no further work is necessary to fulfill the requirements in Section 11 of the CD-RAP.



APPENDIX B

BORING LOGS

This Appendix contains 16 pages.

7	CA			OWNER	•	·	LOG OF	BORING	NUM E	ABER					
1	7	4			. Louis Park			B-1	L						
1129	•	•		PROJECT NAME			ARCHITE								
SIS Co	ısuila	nts L	ld.	Reilly Tar & Cher	nical Corp. Remedial	Action Plai	n City	of St.	Loui	s Par	k Publ	Lic Wo	rks		
SITE	OC.	ATIC	N	,					T				-		
]				St. Louis	Park, Minnesota			Pen	-						
	T							tro	on		= 4		nete		
=	ŀ	1		j					162						
DEPTH (FT) ELEYATION (FT)			ջ	SURFACE ELEVATIO				١.	ŀ				tion	1	
DEPTH (FT) ELEVATION	٠	9	ぼ.		DESCRIPTION OF MAT	ERIAL			n-		۲٤	ppm	1		
H ×	Ž	≿							WS				_		
[E. E.	3	3						pe							
	SAMPLENO	1 3	1 2 2	CUBEACE EL EVATIO	N			fo	at I	5	10	15	20	25	
<u> </u>		1 37	10,10	130HFAGE ELEVATIO	IN .			—- - <u>-</u>			10	- 1			
1 SS										30	}	ļ	l	1	
Silty sand - brown - moist - medium dense - (SM) - Topso								oi l							
				- Fill - no creo		delibe (bii)	, 1003					Ĭ.			
											-	- 1			
		35		<u> </u>	 							!	1		
	2A	ss	11.	<u>_l</u>					15		i i	ŀ		1	
	_	1	ΙĪ	1	/a-m 1	_		ļ							
	1			Clayey silt - bro	own - (MI) - no cred	soce odor	•								
	l			}				ĺ]		
10.2	73	SS	 -	4				ļ				1	1	ĺ	
	_3	35			ilt - dark greenism	black - (OL) - 10	عة ا		-	<u> </u>				-
	<u> 38</u>	<u> </u>	 	il creosoce odor	-			6/6	5"		- 1	ł			
					and, trace sile - or	rown - wer -	medium		- 1\		İ				
	!		┼┼	dense - (SP) - no	creosote odor						 -		-+		
				<u> </u>				-	. 1	\	İ	l	i		
	4	ss	Ш					j	8 ,	53			i	- 1	
	<u> </u>	33	11111	Fine sand - brown	n - saturated - loos	se - (SP) - 1	no creos	oce	- 1 1					- 1	
	Fine sand - brown - saturated - loose - (SP) - no cred								- 17					1	
									-17			- 1			
	i	ļ	H					-	- V		i	- 1		1	
20.0	!								Y.		- 1	ļ	- 1	-	
	5	95							X						
	-	-	<u> </u>		le sand, little grav	rel - gray -	glacial					- 1		Ĩ	
			1	till - (CL) - no	creosote odor					1		- 1	- 1	-	
									1	1			1	1	
			H										- 1	- {	
	6	ce		İ				١.,	. 1		- 1			- }	
	٥	33	1111	Fine to medium s	and, trace coarse sa	and. little	gravel -		3 🕸		- 1		1	- 1	
					i - medium dense - (1	- 1				- 1	į	
				odor		•			- [İ	[
								- 1			- 1			į	
30.0			110	===				31	L 🖺		į		ļ	!	
	7	SS						1	34			İ		i	
				Fine sand France	silt - brown - satu	rared - don	sa - /90	<u>, </u>	A			}	1		
				- no creosore ode			10,	´ \	- !		-				
		-	⊢┼						1	<u> </u>					
	<u> </u>		 	Silty fine sand.	little clay - trace	gravel - b	rown - m	oist	,				1	- [
36.3	. 8	SS			no creosote odor		_	52		1	1	1	1	İ	
10.1		_	щ	 	-				- T						
				F-1 -4	26 5 5			l	- 1				1		
				End of boring at	36.5 feet. stem augered to 19	fr		l	-						
					driled with 2-15/16		and det1	1-	-					-	
					aid from 19 to 36.5		~	⁻		1	-			- 1	
					i boring with neat of		, tremie	.d.		- 1					
					com of drilled hole.				1						
					•				1						
								1		Ì					
		****	<u></u>					!		<u>.</u>			<u> </u>		
		THE	SIMA	TIFICATION LINES REPRESEN	T THE APPROXIMATE BOUNDA	ARY LINES BETWE	EN SOIL TYP	PES: IN-SIT	U. DIE	TRANSI	TION MA	Y BE GF	INDUAL.		
WL	12.	5 Fr	. W:	ws on wo	BORING STARTED	9/6/88		SISOFF	CE		Minnes	SOEJ			
				· 		7/0/00		I							
WL			Ę	ICR ACR	BUING COMPLETED	9/6/38		DRAWN	3Y	кс	SHEET	NO.	OF	I	
wi								APP'U BY	,		STSJC	ON BC			
-					2-50	ī	DН	(" ["] ")	•	DCJ	5.550			94019	- A
DI-LOCAZ					·										

THE PERSON NAMED IN

The same

Í.

10				-	OWNER			LUGUFBU	oning n	JMBER					ĺ		
7	•	1			City of St. Lauis PROJECT NAME	7114		, 3-1 ARCHITEC	T C. (C.)	icen	======================================						
SIS Co	-	ente t	ld.	1		ucai Jaro. Remedial A	ction Plani										
SILE																	
		le .			St. Louis Park. !	linnesoca			Pene-								
	1	1	Г	П					tra	l	= }	dnu	met	er	ļ		
1 6		ŀ	127		SURFACE ELEVATIO				votues								
DEPTH (FT) ELS'ATION (FT)	ļ	ښا	Ę		1	DESCRIPTION OF MATER	PIAI		ston-		_	Hnu meter deflection [ppm]					
DEPTH (FT) ELSTATION	ģ	17.0	Sis	یزا	•	DESCRIPTION OF WATER	11AL		dearel		·	hhu	ני				
[E	19	113	117	Š					blows	ı							
\	SAMPLE NO.	17	1	ü	CUREACE EL EVATIO	INI			- loot		10						
<u> </u>			107	-	SUMPICE ELEVITIO	TV				5		- 13		, 23			
	1	SS	<u> i</u>	쁘	Organic silty san	- (SM) -	45	-									
<u> </u>	1	١	1	}	(fill) - (no cred		att - morac	(32.)	-	1 1	- 1						
=		İ												į			
5.0	<u> </u>	SS	 														
		ISS							376"	3							
==		1				ay - iark brown to bla	ck - (OL)	- (no						1			
					creosote odor)				-								
12-2	<u> </u>		<u>!</u> _	Ц	Cravelly same Fr	race silt - gray - vet	- 10080 -	(52) -	1 3								
10.3	3	SS	Ш		(no creosote odor		20000	(31)			l						
=			Ϊ'	H					 								
		}	İ	1					- [
		1															
15.0-	-	ss	ÍΠ	Ш		und, little gravel, tr		gray -	2	32							
	<u> </u>	133	밷	Щ		e - medium dense - (SP											
	I					e #S no creosote o o for drilling with 2		b his and									
		ļ	ĺ			ing fluid.	13/10 100	k olt and	İ								
20.0		[-	l		 Sample 	a √S−3 - mild creosoce			ļ						· ·		
	-	ss	İΠ	П	4. Sample	e #S-o - mild creosore	odor.		10	193							
	5	SS	쁜	뻐						7		•					
]						İ								
									ļ								
25.3	_	<u> </u>	<u> </u>						ļ	<u> </u>							
==	6	SS	Ш	Н					11	3							
	=		F														
<u> </u>		ļ.		1					1	1			ļ :		1		
30.3																	
	7	ss	Ш	П	Sandy fine grave	i, trace silt - gray -	· sacurated	- loose	- 13						ĺ		
	 -	133	'''	Н	(GP)	•											
==					Notes: L. Sampi	le #S-7 - no recovery.									· .		
35.0		ĺ		Ì		le #S-7A - slight cred			1	1			j				
35.0		-	Ш			Le #S-3 - slight creos			1								
	8	SS	Щ			ng problem from gravel irilling fluid loss so		27.0 ft.	8	3							
		İ '	l '		6. Sec	BW casing to 38.0 ft.			i i	\			,				
					fluid	i loss and caving.	·										
-40.0	q	ss	Ш	Ч					6	33							
			П	╛		le gravei - brown - sa	curated -	dense -									
			[]		(SM) - (creosoce	odor;					ļ						
		1											'				
		ss	Ш	ш	P/	n - saturated - dense	- (FP) - ·	areces:	 	23							
	10	SS	Щ	#		n – saturated – dense s Notes: Boulders and			31			,					
		<u> </u>	Ц		feet, rough dril					1							
==				I													
50+0		<u> </u>	닊		Ciles and Item	le gravel - brown - sa	rurerod -	medium		1							
7010	11	SS	Ш	\Box		sligne creosoce odor)			27	7	ļ						
			H		•						i						
														j			
						race silt - brown - ex	ctremely de	nse - (SM	1)								
-55+0	12	SS		띡	- (slight creoso		ragments		140		1						
-35:3	\neg	П	++	\dashv	Note: 54.5 ft. limestone fragments End of boring at 35.3 ft.				- -								
	Hollow stem augered to 19.3 ft. Rotary drilled with 2 15/16" rock bit and drilling flu					ing fluid			ı								
from 19.0 to 38.0 ft.																	
Set 3W casing to 38.0 it., t						שנ. the switch	to 11" ro	ek bit and	'])			
\equiv	J				Grouted boring w	ith heat dement grout.	. tremied	mczod o						ĺ			
	لــــــــــــــــــــــــــــــــــــــ				of drilled hole.				لــــــــــــــــــــــــــــــــــــــ								
		1116	รเก	VIH	CATION LINES DEPRESEN	T THE AFTHUXIMATE BUILDING	LINES DE I WEE	HISDIL IYFES	: 114-5111), 11	IE THANS	11()(1	AY OF C	MADUAL				
WL 13			t.te		WS OIL WO	BUNING STARTED	9/2/38	S	SOFFICE	Min	nesot	a					
WL L		ft.	**	ěč	n Arm	BOTHER COMPLETED	2,2700	,;,	NAVII BY			THO.	or				
			_				9/8/38			KC_		i	ì	1	!		
VVI						pari brosh		!			1-12	,					

. . . .

NER LOG OF BORING NUMBER City of St. Louis Park PROJECT NAME ARCHITECT-ENGINEER Reilly Tar & Chemical Corp. Remedial Action Plan City of St. Louis Park Public Works SITE LOCATION St. Louis Park, Minnesota Penetra-Hon ■ Hnu meter volues SAMPLE DISTANCE RECOVERY ELEVATION (FT) deflection DEPTH (FT) stan-**DESCRIPTION OF MATERIAL** [mag] dard SAMPLE NO. plows foot SURFACE ELEVATION 5 20 25 10 15 Silty sand, some to little gravel, trace clays - brown -LAISS HILL 13 medium dense - moist - (SM) - fill - no creosore odor 2 | SS | | | Fibrous pear - brown - moist - (Pt) - no creosore odor 3 3 | SS | | | | Gravelly sand, trace silt - gray - saturaced - loose -(SW-SP) - slight creosote odor 13 ∡ |ss |||| 5 | SS | | | | 13 14 ss 6 Fine to medium sand, trace gravel - gray - saturated medium dense to dense 1. S#5 - slight creostoe odor 17 2. S#6 - very slight creosote odor 7 ss 3. Soils rise into hollow stem auger during drilling; jetted out with fresh water 4. S#7 - no odor 5. S#8 - no odor 8 | 55 | | 43 🕸 End of boring at 36.0 ft. Notes: I'. Hollow stem augered to full depth. 2. Grouted boring with neat cement grout tremied to bottom of drilled hole. THE STRAIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES RETWEEN SOIL TYPES: IN-SITU. THE TRANSITION MAY BE GRADUAL WS OR WO I BURING STARTED SISUFFICE 7.3 ft. WD 9/8/88 WL BCB BOHING COMPLETED SHEET NO. 1 OF YBAWARD KC 9/8/88 ПIG FOREMAN STS JOB NO. APP'D BY

D-30

9471944

OWNER LUG OF BURING NUMBER City of St. Louis Park PROJECT NAME ARCHITECT-ENGINEER Reilly Tar & Chemical Corp. Remedial Action Plan City of St. Louis Park Public Works STS Consultants Ltd. SITE LOCATION St. Louis Park, Minnesota Penetration ■ Hnu meter vatu es ELEVATION (FT) deflection SURFACE ELEVATION DEPTH (FT) stan-**DESCRIPTION OF MATERIAL** [ppm] dard blows foot ro 15 20 25 15 3 Organic sandy silt - dark brown - (ML) - fill - no creosota 9 2 | 55 | | | Fibrous peat - brown - spongy - (Pt) - no creosote odor 3 |SS |||||| Amorphous peat, trace fibers, shells and shell fragments - dark gray - spongy - (Pt) - no creosore odor ss ||||| Organic silts - gray - very soft - (MH) - no creosote odor - 15 ft. color change to light gray 5 SS Gravelly sand, trace silts - brown - saturated - medium 12 dense - (SP) - no creosote odor Note: Pumped fresh H2O into hollow stem auger to prevent Iss soil from rising into casing, before taking sample #6. 19 Sandy gravel - brown - saturated - medium dense - (GP) no creosote odor Note: 1. Soils raised into hollow stem auger during drilling. ss 2. Jetted sand out with fresh water before sample numbers 7 and 8. Fine to meduim sand, trace coarse sand, little gravel brown - saturated - medium dense - (SP) - no creosote odor Coarse sand, little fine to medium sand, little gravel -brown - saturated - medium dense - (SP) - no creosote odor End of boring at 36.0 ft. Notes: 1. Hollow stem augered to full depth. 2. Grouted boring with neat cement grout, tremied to bottom of drilled hole. THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL. WS OR WD | BORING STARTED SISOFFICE No water level taken 9/9/88 Minnesoca SHEET NO.

BOHING COMPLETED

DIGEODEMAN

9/9/88

YB MWAND

APP'U BY

SISJOBIJO

WL.

7	OWNER		ŀ	LOG OF BOI	TING N	UMBER	1			
127	City of St. Louis	Park		3-5						
	PROJECT NAME			ARCHITECT	-ENGI	NEER				
SIS Consultants Ltd.	Reilly Tar & Chemi	cal Corp. Remedial	Action Plan	City of S	t. Lo	ıis Par	'X			
SITE LOCATION										
1	St. Louis Park, Mi	nnesota			Pene					
C DEPTH (FT) ELEVATION (FT) SAMPLE NO SAMPLE TYPE SAMPLE DISTANCE	SURFACE ELEVATION	DESCRIPTION OF MAT	ERIAL		tra- tion values stan- dard blaws per		q		met ction	
× 5 5 5	SURFACE ELEVATION	N				0 5	10	15	20	25
1					47	3				
1 155 111	<u>''</u>				''	F 1			-	
2 SS	Silty sand, some dense - (SM) - (ist -	53	1						
	<u> </u>				 		-		<u>-</u>	
3 SS	Fibrous pear - bi	rown - spongy - (Pt)	- (no creos	ote odor)	5	3			1	
	7			· · · · · ·		!!!			Ī	
	Amorphous peat -	dark gray - very so	ft - (OL-OH)	- (no						
	creosote odor)									
15.3								j	1	-
4A ISS III					18	32				-
	Gravelly sand, to	Gravelly sand, trace silt - gravish brown - saturated - medium dense - (SP) _ (no creosote odor)								
5 SS	samp]	i fresh water into h e #5, 6, 7, and 8 t ing into hollow ster	o keep soil .	from	18	3				
6 SS		nd, trace gravel an remely dense - (SP-			67	33				
7 SS	saturated - media	and, little gravel, am dense - (SP) - (n	o creosote o	dor)	10	33				
35.3	odor.		- ,							
8 55					16	32				
		36.0 ft. ed to full depth. th neat cement grou	c, tremied to	o bottom						
THEOR	· · · · · · · · · · · · · · · · · · ·				<u> </u>	1		1		
	MIFICATION LINES REPRESEN		ARY LINES BETWEE	·		HE TRANS	SHION MA	Y DE GF	1ハリリハし.	
12.2 fc. WS	WS OR WD	BURING STARTED	9/9/38	STS	OFFICE	Mfr	nesota			
		BOHING COMPLETED	7, 7, 00	<u></u>	WIN BY	····	SHEET		OF	
			9/9/88			KC		l		<u> </u>
WI.		лістопемли		APP	D 07		313 #	20 (11)		
		• • • • •								

	OWNER			LUG OF BU	F BORING HUMBER								
	City of S	t. Louis Park			BーカB								
	PROJECT NAME			ARCHITEC	T-Ei1GI	NEER							
STS Consultants Lid.	Reilly Tar & Chemi	cal Corp. Remedial	Action Plan	City	f St.	Louis P	ark Pn	blic W	orks				
SITE LOCATION	· L 	· · · · · · · · · · · · · · · · · · ·	 			1		0110 //	o c ics				
	St. Louis Park.	Minnesoca			Pene-	.[
\ 	1				tro-	ì							
					Values	1		ոս ո		٢			
ELEVATION (FT) PLE NO. PLE TYPE PLE DISTANCE	SURFACE ELEVATIO				Vulues	1	d	eflec	tion				
BEEVATION PLE NO. IPLE TYPE IPLE DISTAN		DESCRIPTION OF MA	ATERIAL		-noie	1	۲	ppm]	ļ				
	:	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			dard	1	L.	hh1					
					plows	1							
ELEVATI ELEVATI SAMPLE TYP SAMPLE TYP	<u> </u>				per laat								
× 3 3 5 8	SURFACE ELEVATIO	N			1 ,000	ο 5	10	15	20	25			
	- Silty sand - bro	m - moist - loose	- (SP-SM) -	fill - no									
!AI SS 11	\ creosote odor				_/ 8	3	İ		1				
1	· -	m - morac - Toose	: - (M2-F2) - :	čill - no			1	1		1			
	odor					 \ 			_+				
	1					\			İ				
3 100 1911	T	le gravei - dark b				3	į.	- (ļ				
2 SS	ed - mediu	m 23	11	ĺ	İ								
			1/1										
								1					
	}				1	1/ 1	1	1)				
						 		 -					
3 SS					6	588	- 1						
	식				١ ،			Į.	Ì				
	Amorphous peat.	race fibers, trac	e shell fragme	anre =	[11 1	1	l					
	dark grav - spon	gy - (Pt) - no cre	osote odor		İ	{	i	-					
		. , ,				ll i		ł		-			
4 55 111	.]				1	1)	1	}	l	Ì			
4AISS III					- -	-	$\overline{}$						
	'				2			[
1==-	Organic silt - o	ray - (MH-OH) - no	crocere edes	_	1	11		}	- 1	- }			
	1 3 3 8-	(121 011) 110	- creosore 0001	•			- 1	- 1	1				
	<u></u>					1			<u> </u>				
20.2 5 SS	Amorphous peat,	race snell fragme	ncs - brown -	(Pt) - no	3/6'	ايسا	1	j	İ	1			
2A 28			···		8/6	 							
	Gravelly sand. f:	ne to coarse sand	→ grav - sacu	raced -	1 , ,	11 1	- 1	į	1				
	medium dense - (P) - no creosore	odor			11 1			1	1			
	\ ·				1	1) 1	1	ì	1	1			
						Ŀ							
6 SS	Sandy fine to me	lium gravel - gray	- 625usasad -	- modifium	14		- 1			j			
	dense - (GP) - no	creasate adar	- sacuraceu -	. medium	1 14	11	1		-	- 1			
	(32)						ŀ	Í	I	- }			
	<u></u>					[]							
	Sandy clay some	silt, trace grave	1	<i>55</i> (07)		11	}	ļ	1				
30 3 7 99 1111	- glacial till	Sile, trace grave.	1 - gray - sti	.rr - (cr)			1	Ì	- 1				
70 Y 7 SS	8				11	33							
75155	7					11		1					
	1				1	i\ \	i	1	1				
	Gravelly sand - s	ray - sacuraced -	medium dense	- Inces -			- 1	- 1					
	(SP) - no creosot	e odor			ŀ	11 1	- }	1					
8 55					1	200	Ţ	ļ	ļ	ļ			
20.2	Y				8								
	End of boring at	36 0 fe		_		1 [}	1		1			
		resh water to hol] Ott	hae			-	Ì	-				
	anh as	mple below 11 foot	pelon arona,	eurface	1	1 1	1	1	Ì]			
	2. Drilled	with hollow stem	auger to full	denrh	1	1 1	- 1	İ		Ì			
	-3. Grouted	boring with near	Cement group	rremied	1	1		Į	}				
		om of drilled hold			1	1	1		1				
							ļ		j				
<u> </u>					ı	1 1	- 1	- 1					
					1	Į į		1	ļ				
						1 1	1	Ì	-				
<u></u>					_1	<u> </u>							
THE SIDA	HEIGATION LINES REPRESEN	T THE APPROVILIATE BOLIS	DARY I INCORPANCE	N CON TYPE	- (N. C1711	THE THAN	44 MOIT 12	AV RE CO.	ADUAL				
			COULT CHES BE I ME!		IS OFFICE		J. 1 (C) (4 (M)	., 86 01/					
WE WS ON WE BORING STARTED 9/12/88							ii nn c c						
1	000	Baning	7/14/38	_			iinneso		or.				
) WL E	ACT ACT	BORING COMPLETED	9/12/88	0:	NAWN BY	кс	SHEE	TNO. L	OF [
WL		RIGFOREMAN	7. 12,00		PP'D BY		515 "	DB 110.	- _				
1		D-30	DH	^"	- U U T	(מני	: 33.4		ሳር): ~ + /			
		-				· 							

(~	1		City of S		LOGOFE		114G 14 B-7	ionine:	1					
	•	Ч		PROJECT NAME	ARCHITE			NEER				·			
STS Co	<u>-</u> ngult:	ints L	ld.	Reilly Tar & Chem	ical Corp. Remedial						ark Pu	blic	Works		
SITE	OC	ATIC	NC	Co. Tanda	7i- W			Ī							
				Jr. Louis	Park, Minnesota				Pene tro						
									lion values			lnu			
DEPTH (FT) ELEVATION (FT)	}		9	SURFACE ELEVATION				- 1			_	lefle		П	
DEPTH (FT) ELEVATION	ġ	SAMPLE TYPE	1212		DESCRIPTION OF MAT	ERIAL			stan- dard		Ļ	ppm	ו		
1691 1.EV	Ē	LET	LEG .						blows per						
	SANIPLE 110.	der.	N C	CUDEACE ELEVATIO			 		faat		. 10	, ,	7.	0 7	_
		-			l - dark brown					0 5	10	1.5	21	0 2.	-
	1	SS	- i		le gravel - brown -	moist - medi	ium dense	[16	3		ļ			
		ļ		(SM) - fill - no				_							
		Π								1					
	2	55	liili	Silry clay, some	sand and gravel - m	orrled brown	e and ar	ravd	31	🕹		1			
	<u> </u>	100	1,111		no creosote odor	.beezea brow.	5.	7							1
								- 1							ŀ
	<u> </u>	<u> </u>	<u> </u>	1						11		!			<u> </u>
10.1	3		111	1				ł	5	Ľ l					
	د ا	33	<u> </u>	i oravazz, sama, c	race silt - brown -	saturated -	loose -	ĺ	_						
		}		(SP-SM) - no cre	osote odor			į				İ			
		}										į			1
	<u> </u>	<u> </u>								-					<u> </u>
	4	ss			and, little gravel,				7]		ĺ			
			П		aturated - loose - (SP) - no creosote odor - color chango o gray at 15.2 ft. below ground surface										İ
	<u> </u>	<u> </u>	<u> </u>	<u> </u>								<u> </u>			
				Note: L. Added H	20 to hollow stem to ing.					İ			ļ		
70.0	5	ss		2. Jetted out 2	ft. of sands, which	heaved into	casing,	Ì	15	3		ł			
	-		1	with fresh water	•			- 1							
	ĺ					•		j							
					and, little to fine		own -	- 1		.	1				1
	5	ss		saturated - 100s	e - (SW) - no creoso	ce odor		1	9						
	۳	55	<u> </u>	1								ĺ			
		ŀ						1							
70 1	7	00	11111	1		-				778					
=		SS	\overline{m}]				1	9						ţ
				Fine sand - brow	n - saturated - loos	se - (SP) - r	no creoso	oce							
				odor							Ī				ļ
	<u> </u>	_	! ! !!!!!!	1]	10						
<u> </u>	8	SS	ШШ			· · · · · · · · · · · · · · · · · · ·									<u> </u>
		ŀ		End of boring at											
					d with hollow stem a			, 1				ŀ			į.
<u> </u>					d boring with neat o tom of drilled hole.		, cremied	۱ '							
								İ							
					•										
				-											
==															
		THE	SIRA	IFICATION LINES REPRESEN	IT THE APPROXIMATE BOUNDA	IRY LINES BETWE	EN SOIL TYPE	E5: IN-	SITU.	NIE TRAN	ISITION M	AY BE G	NADUAL		=======================================
WL	÷	9 =-	. 75	ws on wo	BORING STARTED	/12/88	1	SISC	FFICE		linneso	ra			
WL	٠.				BOUNG COMPLETED			DRAW	VN 70			TNO.	OF		
]9	/12/88				KC	_	<u> </u>	OF l		
WL					RIGEOREMAN D-30		Dri	APP'[יח ל	3.7 *	SISJ	ดากด	,		

-	7	OMNEH			OG OF BO		UMBER	ł			
1276	٦	City of St	. Louis Park			B-3					
	' '	PROJECT NAME		F	ARCHITECT	r-ENGI	NEER				
STS Consult	lanis Lid	Reilly Tar & Chemi	cal Corp. Remedial Ad	ccion Plan	City o	î St. I	Louis	Park P	ublic	Works	
SITE LOC	CATION			i		1					
]		St. Louis ?a:	k, Minnesota			Pene-					
l	, , , , , , , , , , , , , , , , , , , 					tro-					
1 1		ŀ				tlan			ពែប រ	mete	Γ
DEPTH (FT) ELEVATION (FT) PLE NO.		SURFACE ELEVATIO				values			efled	ction	
LE X	\		DESCRIPTION OF MATE	DIAL		stan-					
부팅하	YP Y	ļ	JESCHIP I IQIA QP MIATE	HIAL		dord		Ļ	ppm]	
DEPTH (FT) ELEVATION PLE NO.	# 01E	}				plows	1				
유 피 로	4 E S					per					
ELEVATI SAMPLE NO	3 3 9	CLIDENCE EL EVATIC	N			- foot	! 0 5	10	15	20	25
	W 1314	SUMPACE ECEVATIO		25.					1.3		- 23
<u>-</u> -	SSi i:	Jugare enbanti,	re-r - piacx - spong	y - (EE) - E	on Creusat	3/6"					į
	33 -	j						1	1		
		Ì				-	!!!!				ł
	1 1 1	•				5/6"]				İ
			ind, trace gravel, tr				ļi ļ	- !			İ
2	ssiilii	moist - loose - :	medium dense - (SP-SM)) - no creos	sote odor	10	3			1	
 -	1	!					lı l	i	- 1	1	
	f (Note: Wet to sate	raced at approx. 5 fi	C.			11			1	
								i	- 1		
<u> </u>		<u> </u>				1.					<u> </u>
10	4 . 17 .	i					L				
3	ssi					16	3	1	1		1
	1 1					1				i	
<u> </u>						1		ļ	ł		
		Fine to coarse sa	and, trace gravel, tr	ace silt - t	orown -	. }		1	- 1		
			m dense to loose - (SP) - no cre	eosote			- {	1		
	1 10111	l odor	•			2	<u> </u>	- 1	l	İ	
4	ssilli	[-		[1		
	TTI					İ			1		
		ł						ŀ	1	- {	
	1 11					1	li l			ļ	Ì
	+-+-					-	11				!
70.0 5	ss IIIII		water into hollow s		o prevent	23	3			}	
	33 11111	heaving of soil	efore all subseugent	samples.		j	l: !	- 1	- 1		1
i	1 1						[] [
	1 1 1	Graveily sand, to	ace silt - brown - s	acurated - :	nedium		li i		- 1		
	1 1 1		no creosote odor				}		ļ	İ	
<u> </u>	135 1111					ł	l' i	ļ.	1		
1 0 2	155 11111	Congression - G	ray - sacurated - med	1	TC*15	5/6"-	<u> </u>		} -	}-	
	3 55	no creosore odor		rum dense -	(64) -	/5/6"	i i				
	T i i		Le to some silt, litt	le gravel -	gray -	-				ŀ	ļ
l	1 1 1		L) - no creosote odo		6-47	L					
l		\ <u>3</u>				-	lı İ	_		ĺ	1
20.0	1 ! ! !					10	ᄔᆝ	- 1	1		
7	ss					10		- 1		ŀ	1
 -	1	Fine to coarse sa	and, trace gravel - b	rown - satu	rated -		11	1		ĺ	Ī
	1 []		SP) - no creosote odo					į	}		
	1 1		vith fresh water befo		Six of our				1		
			sand out of hollow st			.]]	Ī	1		
8	ssiii						Line i	1	1		
36.0°	33	2. Sample 78, co.	iring drilling. Lor change to gray at	35 ft., no	creosote	ddo t					
		_								Ì	
		End of boring at	36.0 ft.		e			1]		
			with 31" hollow ster			\-\		1	i		i
	1 11		l boring with near cer	ment grout t	cremied	1	j l	i			1
		נס מסבו	com of drilled hole.]	ŀ		ļ	
							ļ į			ļ	
								Į	- 1	1	i
 								ļ			
			•					!	!		
								ŀ	ŀ	1	
								- 1			1
										1	1
	1 1 1					<u> </u>	<u> </u>		L		<u> </u>
	THESTOAT	IFICATION LINES REPRESEN	T THE APPROXIMATE BOUNDAR	Y LINES BETWEE	N SOIL TYPES:	m-situ, t	HE TRAN	SITICN M	AY BE GF	RADIJAL.	
WL			BORING STARTED								
	ft. WE	442 OH MD	DOMING STATTED	/13/88	Si	SUFFICE	м	inneso	ca.		
wi.		CR ACR	BORING COMPLETED			AWN BY			TNO.	OF	
-	5	non		/13/88	"	7 (1 4	KC	3,768		ı ı	
WL			RIGFOREMAN			P'D AY		SIGJ	UB 11O.		
			0-70		DH		DC:	1		94010	\ - \
.,								-			

į.,

7	İ		OWNER		LOGOFB	IORING N	IUMBE	R							
777	City of St. Louis Park				B-9										
	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \					ECT-ENGINEER									
STS Consultar	nts Li	d.	Reilly Tar & Chem	ical Corp. Remedial Action Plan	City	of St. L	ouis.	Park Pu	blic Wo	orks					
SITE LOCA	ATIC	N			•		Ĭ								
			St. Louis Par	rk, Minnesoca		Pene	1								
		П				llon	į	= !	inu r	note					
E		ш		•		volues									
DEPTH (FT) ELEVATION (FT) PLE NO.		읳				stan-	}		deflec						
DEPTH (FT) ELEVATION IPLE NO.	9	E.		DESCRIPTION OF MATERIAL		dard	Ï	Ĺ	ppm	ļ					
£ \$ [\frac{1}{2} \]	<u></u>	0 6				piows	1								
# 교 교	골	륈				per	1								
SAMPLE NO.	448	3 8	SURFACE ELEVATION	N.		— foot	0	5 10	15	20	25				
		11:11	Organic sandy si	lt - black - moist - topsoil -	f111 -		7.0		— <u> </u>		— -	=			
	SS	Щ	no creosoce odor			_/\ 10	7	1		-	- 1				
		1 1	Silty clay, some	sand, little gravei - brown -	moist - f	111	11		- 1	l					
			- (CL) - no creo	soce odor			П			- 1					
			!				!			<u> </u>					
2	SS	Ш				6		1	- 1						
		111111	Silt - greenish	coior - saturated - very soft -	- (MH) -	į	1			1					
		{	no creosore odor		(1-1)	- 1	Ц	1 1	- 1	- [ļ				
											İ				
		ᄔ	<u> </u>			ļ	 	-{			<u>'</u> -	_			
12.2 3	92		1			15	3	1	- 1	- 1					
	٠,	ЩЦ	1				11		1						
				gray - saturated - medium dense	: - (SP) -	.	11				}				
			no creosore odor	•		{	Ц	1 1	- 1		. [
							11	1 1							
	_		-				<u> </u>	<u> </u>							
4	ss		1			17	Þ	1 1	1	.	1				
			Sandy gravel - g	ray - saturated - medium dense	- (SP) -		11	}	- 1		}				
			no creosoce odor		•	ļ	[]	1 1			Ì				
	,		CSI En Cion Miss	le sano ano gravel - gray - gla	-2-1 -211	—		1 1	- 1	1					
20 0 3	-	Ц.	1 /		cial cill		11	<u> </u>							
5A						17	28	 	- +	- 					
	33	-	†				17	1 1		ĺ					
]					1 1			Ī				
	i	' 	İ				11		i						
						8	2	1 1	l		ł				
6	ss	III:	4			ŀ	ļ .	1		1	ĺ				
		Щ-					11	1 1	-		ł				
	Į								l l	Į	ł				
	ı	- 1	Gravelly sand, to	race silt - brown - saturated -	medium	l		1 1		į	- 1				
			dense - loose -	(SP) - no creosote odor		9		1	ļ		1				
30 31 7	ss	ПΞ	į				1_		ſ						
	22	<u> </u>]			Ì	3	1 1)]				
	1	- 1						1 1	- 1		ŀ				
	[-						li							
	Ì	ì	,			1		1	}	j					
		nh				10			-						
16.11 8	ss	ЩЩ					33								
	Ī	Ī								T					
	-		End of boring at	36.0 ft.		.			1						
	- 1		Notes: 1. Drilled	i wth 3½" hollow stem auger to	tull dept!	n.	1								
	ì	Ì		fresh water to augers, before s vent sand from heaving.	ambre ≗Ω'	1	}	1 1	1	Ì					
					g sample	#8]	Ī]]							
		İ	approx	 Jetted with fresh water, before taking sample #8 approx. I foot of sand out of hollow stem auger which heaved up into augers during drilling.]	1		-				
	- 1		which !					1 1	}	1					
			4. Grouced	i boring with near cement grout	tremied	- 1			- 1	- 1					
			co bot:	om of drilled hole.		- 1]	-	ı				
	- 1					1	1	1 1	1	}					
			li			1			1						
						!	<u>.t</u>	!				==			
	HES	TRAF		T THE APPROXIMATE BOUNDARY LINES BETWE	EN SOIL TYPE	S: IN-SITU.	THETTIA	HISITION N	AY BE GR	ADUAL.					
WL 3.2 ft.	. 78	5	WS OR WO	BORING STARTED 9/13/88];	STS OFFICE		Minnes	ota						
VL.			IR ACR	BOHING COMPLETED		20 41-12/201			TNO.	QF.					
		O.	ACR.	9/13/88	1,	YB MWARD	кс	SHE	1 140.	GF L					
VL.				RIGFOREMAN	 [-	APP'U RY			ON BOL		,				
				D-30 DH				_!		940.	·				
				•											

HE TRANSITION MAY BE GRADUAL. Minnesota KC SHEET ND. OF 1 SIGNORIO.								
TE TRANSITION MAY BE GRADUAL. Minnesota								
1 1 1 1 1								
9								
20.								
50								
5 10 15 20 25								
2								
[ppm]								
deflection								
■ Hnu meter								
uis Park								
ECT-ENGINEER								
OG OF BONING NUMBER								

The state of

1	-	٦		OWNER		1	LOG OF	BORING	NUMB	ER						
1167	~	◀		City of St. Louis	Park		B-11									
 		.1	PROJECT NAME ARCHITE					ECT-ENGINEER								
	<u>~</u>			l .	.cal Corp. Remedial Act											
S13 Co				Relity far a Chemi	edi Corp. Remedial Act	tion Plan	CIEN 9	f St. Lo	uis P	ark						
SITE	OC.	ATIC	NC						1							
İ				St. Louis Park. Mi	nnesota			Pene	L							
	1	T	1 1					tra-		_						
_ ا	1	1						value	ŀ			mete				
DEPTH (FT) ELEVATION (FT)		1	삥	SURFACE ELEVATIO				Value:	*		defle	ction				
ا ج	ļ	l	 		DECORIDERON OF MATE	~		stan-	_!		_					
DEPTH (FT) ELEVATION	o	١٩	15	.]	DESCRIPTION OF MATE	HIAL		dard			[ppr	וו				
	ž	15	Die					blows								
1 1 1 1	1 2	1 2	12.2					per								
<u> </u>	SAMPLE NO.	3	30					- loot								
	တဲ	ြတဲ	30 12	SURFACE ELEVATIO	IN .			- [0	5 10	15	20	25			
	1	نتا		4 Silty same - ord	wn - moist - medium d	ense - (SM) - (aspn	alt								
	1A	. 45	$ \cdot $	base macerial -	no creosote odor)		•	/	7	1	1		1			
	-		11	1				— <u>I</u>	11		}		1			
<u> </u>	!		1 1	Silty sand, litt	ile gravel - black - m	oist - med	ium dens	e	- []] }		İ			
			1 1		- (creosote odor)			1	11		1 1		1			
		<u> </u>	11		,				H		ł I					
-3		1 3 3						<u></u>	- <u> </u> -	<u>.</u>	├─	- !				
	ZA.	1 55	11111	1				19	3				- 1			
	t	1		Amorphous seac.	trace fine sand - bla	ick - moist	- spone	,	-li	İ			į			
	ł		\mathbb{H}	- (Pt) - (no cre			300115	''	Ш	1			İ			
	1	1		- (12) - (10 12)	.osoce odory				-11	1]	1 1				
<u> </u>	 	!	; 						1.		 					
-:0:0		i	111111	.1				111	2		i i					
<u> </u>	3	SS	111111					**	.				i			
			i I		race silt - brownish g		rated -	1	- 11	1	! !					
	i	[medium dense - ((GP) - (no creosote od	ior)		}	- 11	-						
I=	ł	Ì						1	1)			1				
	1							l	11				- 1			
₩3.3	⊢	\vdash	!	 							 		 -			
	4	SS	111111		md, trace coarse sand			40	33				į			
		 	1 1		saturated - dense - ((SP) - (no i	creosote	.	lı .				i			
		<u>├</u>	 	odar)	· · · · · · · · · · · · · · · · · · ·				11			<u> </u>				
	İ	ı		1				Ì	-ti	1	1 1	1	- 1			
[=-		į			th fresh water to rem		of sand		- II	1	1	[
-20.0		<u> </u>	1 1	-	into augers while dri	illing.		1	11	1)	1	1			
	5	99	1111	1				10	31				į.			
		1 33	1111	•				1 -0	- 11	j	i l		i			
	l	1		Silen alan 1/2	le sand, trace gravel		(CT) =		11	i	1 1		- 1			
		l			- (no creosote odor)	gray -	(CL) -	ı	H	- 1			1			
	i		1	(gradial citt) -	(no creosure odor)			- 1	Ш	1	1 1		- 1			
				}				ŧ	-11	Ì	1 }		1			
-25.0	,		Hill	†				ر ا		1			1			
	6	55	MF	Ĭ				24	П		l i		1			
		i	l i	7				ľ	11	1						
			1	1				ŀ	- 11		l i					
<u> </u>		-	1 :	} _							 					
	1	İ							11	1			1			
[- 20.0 [<u> </u>	1 1						11.	Ì		j	- 1			
	7	SS	111111	}				13			1 1		1			
	_			Fine on matter	1411 .			ł	l:		1	i 1	- 1			
		}	1 }		and, little gravel, t				11	}	1		1			
			1 1		lum dense to loose - ((SP) - (no	creosote	•	- }	į	{					
			1	odor)				ľ	11	i	1 1					
35.0		<u> </u>	<u> </u>	!	•				- 11				1			
	8	00		İ				9					1			
36.0	٠	33	111111	<u> </u>							↓					
		l		End of boring at	: 36.0 ft.	•			1	1			- 1			
		Į .			hollow stem augers to	full dene	h.	1	1	ļ						
		1			with near cement grout			.m. {	1	1	\ \	1	- }			
		l		of drilled hole.		.,		-	1				- 1			
				or attited upte.					1							
		Ī	1	,				1	1		j 1	, 1				
		l		İ				İ			j i	. 1	1			
								ł	1				1			
									1			. 1	- 1			
===			.			•			i	1			1			
<u></u> -	,								1	-	1		[
	- 1	-							1		j		i			
	1											,	-			
			<u>'</u>								<u> </u>					
		THE	STRAI	IFICATION LINES REPRESEN	T THE APPROXIMATE BOUNDARY	Y LINES BETWEE	N SOIL TYP	ES: IN-SITU.	THETO	MOITIZITA	MAY BE G	IRADUAL.				
WL																
***	12.2	. £c	. %5	WSORWU	BORING STARTED	9/21/88	Į	SISOFFICE	• ,	iinneso	са					
WL .				EDA RU	FOUND COLUMN			1000			-7110					
W.C			31	ACF!	BORING COMPLETED	9/21/88		DUVMN BA	к	: SHE	ETNO.	l OF	l			
wi					DIGFOREMAN						JOB HO.					
***.					D=30 .			ላ ይይ,በ ሀሊ	on.	; f ^{sis}	JUITED.	47.74	3-4			
	-							•				٠.				

1				OWNER LOG OF BOR							UMBE	4					
127	1	1	City of St. Louis Park B-12														
1		PROJECT NAME ARCHITE						ECT-	CT-ENGINEER								
SIS Co	2. nsulta	inte L	ld.	R	eilly Tar & Chemi	cal Corp. Remedial Actio	n Plan	City o	ŕ St.	. Lou	is Par	k					
SITE	LOC	ATIC	N														
				S	t. Louis Park, Mi	nnesota			- [Pene-							
	·	П	П				•	***		tra— Llon		■ H	lnu	met	er		
. €			삥	1	URFACE ELEVATIO					vaiues				ctio			
E §		ш	Ž		r	DESCRIPTION OF MATERIAL				stan-	••						
H.	ã	2	S	<u> </u>	•		•		ļ	dard blows		L	ppm	י בי			
DEPTH (FT) ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	밁	81						per							
10 T	¥ .	77	17		UDEACE EL EVATIO	Nt .			[foot	, ,	10	1 6	21	n 2	c	
	-"		97	1113	UNFACEIELEVATIO	19	 					3 10	15	21	0 2	- -	
	l l	SS	i	Ш						17	3	1				ł	
	1	<u> </u>		7							li .	l i					
	1		П										İ			1	
	ļ			_	Silry sand, littl	.e gravel - brown - moist	· - medi	um dens					1			1	
33	2	ss	IIIP		(SM) - (fill) -(r				_	14	3		ŀ				
	一	1		\dashv					- 1	•	Γ		i				
	1	1															
					Note: Jetted wit	th fresh water before tal	ring sam	nle 3									
-0.3		<u> </u>		- 1		id from inside hollow ste			-				1				
		<u>\$\$</u>		₩-	Fine to medium sa	ma, little gravel, trace	sile -	orown		7757						<u> </u>	
	23	بععا	П	7_	wet to saturated	- loose - (SP-SM) - (no	creosor	e ødor)		7/6"		i	i		1	1	
				1	Organic silty cla	y - black - (OL) - (no o	Tensore	odor)	/\		<u> </u> ;						
		ļ		- 11					/				j			1	
15.0	=		11.			und, trace gravel and sil : (SP-SM) (creosoce o		y -	Λ		ı						
	4	SS			'				-/	32	3						
				7					-		H						
	1								ļ				l			Į	
									- 1					·			
20.0	 		h	п]]	1				
	5	SS	Ш	Щ						9			İ				
		ĺ							Ì								
<u> </u>					Fine to coarse sa	nd, little gravel, trace	silt -	grav -									
=	1		ļ			to medium dense (SP) - 1											
25.0	_	ss		Π.					ŀ		L]				
	6	55	1111	Щ,	Note: 25.5 ft S#5 loose	color change to dark gr	ау		ł	18	3 3						
		i			0.0 10000				- }								
		ŀ							I		li						
				_					ł				ı				
-30:3-	7	ss		9						15	3						
	 	-		-							1						
									-								
				/-	Time re cos	and come amount and	-1e		─ √								
35.0						ind, some gravel, trace s mely dense - (SP-SW) - (or) †		Ĭ.				i	Ĭ _	
	8	ss		7		· (94 9.1)			- /	8 3/6"	73		1				
36.0					End of boring at	36.0 ft.			i						i		
				1	Drilled with 3½"	hollow stem augers to fu											
				- (Grouted boring wi	th near cement grout, tr			m.				į				
				'	of drilled hole.				I				[
									İ				ĺ				
<u> </u>									- 1				j				
															ł		
									- 1								
			-	1									l				
																1	
				<u> </u>					<u> </u>				!		<u> </u>	<u> </u>	
		THE	SILV	MIFIC	AHON LINES REPRESEN	THE APPROXIMATE BOUNDARY LIN	ES BETWEE	N SOIL TYP	'ES: 114	SITU. T	HE TRAI	IST HON MA	AY BE G	NADUAL	L		
WL					WS OR WD	BORING STARTED			SISC	FFICE							
1001						domino dos estados	9/22	/88			Mi	nnesot		OF.			
WL				BCR	АСП	BOHING COMPLETED	9/22	/88	DRAV	VI4 8Y	кс	SHEE	TNO.	OF	ı		
VVI.						DIGEOREMAN	2/22		APP'I	ny		515 10	OB HO				

でする。 ・ ではない。

1	OWNER		LOG OF BOI	ITING N	IMBEH				
2727	City of St. Louis	Park	B-13					_	
	PROJECT NAME		ARCHITECT	-ENGII	VEER		-		
STS Consultants Ltd.	Reilly Tar & Chemi	ical Corp. Remedial Action	Plan Cirv of	St. Lou	is Park	•			
SITE LOCATION									
	St. Louis Park, Mi	innesoca		Pene-					
		··		tro		= U=	u m	-+	
				values					
DEPTH (FT) PLE NO PLE TYPE PLE TYPE PLE DISTANCE	SURFACE ELEVATIO					_	flecti	on	
DEPTH (FT) ELEVATION IPLE NO IPLE TYPE IPLE DISTAN		DESCRIPTION OF MATERIAL		stan-		[p	[ma		
H				plows					
ELEVATI ELEVATI SAMPLE TYP SAMPLE DIS		i		per					
	SUBEACEIEI EVATIO	N		foot) 5	10	15	20	25
	Organia cando ati	Lt, trace clay - dark brown	- moior -	4/6"			1.		
1 SS 1		: - (fill) - (no creosota d		6/6"			- 	 	
	(12 32	(222) (2220022	,401,	1070	-		1		
		•			1				
						ł		- 1	
3:3	Í		,	5	1	ĺ	- 1	- [-
2 SS		black - spongy - (Pt-DL) -	· (no creosoce	1	7			ĺ	
	odor)					Ì		-	
 				}	1 1	- 1	- 1	Ì	
				1	1 1	1		1	
10.3	 		 	<u> </u>	- -			 -	
3 SS	}			6	2	1	ł	1	
				1	1	-		- [
					1	1	- 1		
			(75)	, ,	J j	}] .	
	Amorphous peat, i	race fine sand - brown - s	spongy - (rc) -		1 1	1	ļ	- 1	
4 SS	/uo creosoca odo:	-,		ا و ا			- 1	İ	
7 30 111	4				ī	1		1	
				1 1	1 1	ĺ	- [1	- [
					l				<u> </u>
					ī l	1	1	_	
20.0	4			1 1	1	ľ		ı	1
5 SS	<u> </u>			9	2	- 1		- [
	7				1				1
		ine to coarse sand, trace s		1		}	ł	1	
	saturated - loose	e - (SW-SP) - (no creosote	odor)	ļ		1	- 1	1	
25.0					1 }		ļ	- 1	Ì
6 SS	4			6		1)		}
	+				1		ļ		ļ
 	 				1				
					1				İ
30.0			(em)			[ĺ	1	
·		le sand, trace gravel - gra (no creosote odor)	ry - (CL) -		<u> </u>	1		ł	
7 SS	(gracial cill) =	(no creosote odor)		21	=				
					1 1	l	1		1
				 	1				
	Gravelly sand r	race silt - brownish gray	- saturated -		1		l		
35.0	loose - (S2) - (1				1		ł		l
8 SS		·		6	2	-			1
26.3	End of boring at	36.0 %		1					1
	Drilled with 32"	hollow stem augers to full	depth-		-	l	1	-	1
		ith neat cement grout, tres							
	of drilled hole.		- · · · · · ·	1					1
]]			ļ
								}	
						Į.	ł		
					1	1	ł		
					ļ				
					ŀ				
	<u>!</u>			<u></u> _					1
THE STRA	HEICATION LINES REPRESEN	THE APPROXIMATE BOUNDARY LINES	BETWEEN SOIL TYPES:	IN-SITU, T	IE TRANSI	HON MAY	BE GRAD	UAL.	
WI.	WS OF WD			SUFFICE					
6.5 fc. WS	773 UH WU		/22/88	J J1 1 10E	Minn	esota			
WL B	CR ACR			VMN B.A		SHEETA		<u> </u>	1
			/22/88		KC	ļ. <u></u> .	1		1
wi.		DIGCODENAG	. ארי	O.D BA	-	SISJOS	(110)	٠.	

100 m

16	_			i	OWNER			LUGOF	niinos	iil	MBER					
7	1	1			<u>CLEV OF SE. LOUIS</u> PROJECTNAME	Para		3-14 ARCHITE	CTE	rait.	EE5					
515 Co	<u></u>	mig L	ld.		Really Tar & Chemi	cal Corp. Remedia						:				-
SITE								-								
					St. Louis Park, Y	linnesota			Pen	7— 10—						1
		Г							11	on l		≡ Hn	u m	nete	эr	l
Ē			ü						vale	nea			(lec			-
E S	۱	H.	5.44		1	DESCRIPTION OF M	ATERIAL			m- rd			[ma			
GEPTH (FT) ELSTATION (FT)) N	7.	Ö	É						1W 3			-			
2 4	SAMPLE NO.	4	MP	ត្ត	SURFACE ELEVATIO					er ot						
XL.	3	3	ŝ	Ξ	SURFACE ELEVATIO	N			<u> `</u>	Ü	5	10	15	20	25	
	1	SS		l i	Silty clay, some	sand, trace grave	el - brown - (C	L) - (f:	1111 7	23 P	•	- 1	- 1	-	:	l i
			П		- (no creosote oc									1		
===										İ				- 1		
3.3-					Fine sand, trace	si't, trace aray	: - brown - mo	nise -		15						
	2	SS,	Щ	11	meaium dense - (S	P-SM) - (possible								ļ		1
	_	i	Ц		odor)					_						<u> </u>
										1		1				
∶0.0	<u> </u>	SS		П	#4 #4b	: - dark prown - :		- (8+)	_	5 5	!					
	3	33	Щ	Щ	(no creosote odor		TOTAL - Should	- (24)	·	I		- 1		- 1		
	1	Ι.								}						
								<u> </u>		_	<u> </u>					
-:5.0	4	ss	ī	П						13						
	ب	33	Ш			ınd. little grave			sin	13	1	İ				-
					gray - saturated	- medium dense -	(SP) - (no cre	eosote o	dor;	- 1				ŀ		
_														- 1		
29.3	Ę	SS		П			-			20	-					
	5	33	Щ	-111	Fine sand, trace	medium sand, tra	ce coarse sand.	, trace	j.	١	·	į		ı		
		1				- gray - saturate	d - medium dens	se – (SP) -							l i
					(no creosote odo:	- ,			-							
-25.0	ó	ss	П	Ш						13						
=	l °	33	Щ	Щ		Le sand, trace gr		(CL) -		ا ``	-	İ				
				-	(glacial till) -	(no creosote odo	r)			- 1				ļ		
\equiv																
20.0	7	ss		П						13						
\equiv		33	1111	쁘		silt, trace grav) -	İ		-	ĺ				
					(glacial till) +	(no creosote odo	rs)]						
		<u> </u>	Ц	_	. <u>.</u>											
-35.0	8	SS	Ш	Ш						20				ł		1
\equiv	_	 -	Н	끡					Ì	- [.		ł	1		
==				ĺ		and. some gravel,				- [
				-	brown - saturated odors)	i - medium dense	- (SP) - (no c	reosote	1	ļ		1				Į
0.0	9	55	Ш	디						21						
=	<u> </u>	<u> </u>	₩	+	Note: 39.5 ft.	- color change to	brown.									•
																1
			Ц	4					-		<u> </u>		_ _			
	10	SS	Ш	П						10						
==			۳	4	Fine to medium s	and, trace silt a	nd gravel - bro	own -			ī ſ					
\equiv						um dense - (SP) -				-			1			
50.0																
	11	SS		\blacksquare					ļ	17						•
-51-0			"	1	End of boring at	51.0 fr				寸		- -	$\neg \vdash$	_		1
=					Drilled with hol	low stem augers t		_		1						
					Grouted boring wo of drilled hole.	ith neat cement g	rour, cremied	to botto	m.							
					or diffied note.											
\equiv													1	-]
=	ļ	- 1														
==	ı											İ				
									i							
]	┙													
		THE:	sin	VIIE	TOATION I INES DEPOESEN	THE APPROXIMATE BOUR	IDAITY LINES RETWEE	NSOIL IYE	ES: III SH	IJ, II	E IDALIS	THOM MAY	DE GOA	OUAL.		
WL LC	1.1	ft.	719		WSORWD	BUNING STARTED	9/23/88		SISOFF	CE	Min	nesota				
WL T	•			ĒÇ.	п леп	BORING COMPLETED			ÜÜVAAİİ	17		SHEET	υ., ο	OF		
_{va}						marror sai	9/10/88					_ <u></u> ,: <u>.</u> ;	: -			!

marraeusa.

7	7				OWNER		LUGUF	BOR	ING N	UMBER	7				
1	1	┫			City of St. Louis	Park	B-15								
	•	1			PROJECT NAME		ARCHITE	ECT-	ENG	NEEA					
SIS Co	 nsv#:	ants L	td.		Reilly Tar & Chemi	cal Corp. Remedial Action Plan	City o	of S	t. Lo	uis Pa	rk				
SITE	LOC	ATIC	NC					Ī		1					
					St. Louis Park, Mi	nnesoti		-	Pene-	1					
	Π		Γ	Γ					tion	ł		Hnu	met	er	
E			삥		SURFACE ELEVATIO				volues	1		defle			
DEPTH (FT) ELEVATION (FT)		<u>m</u>	3			DESCRIPTION OF MATERIAL			stan-			[ppn		••	
H IN	ā	12	Sia	l٣	}			ļ	dard			rbb	٠,		
DEPTH (FT) ELEVATION	SAMPLE NO.	PLE	12	18					per						
ত্থা	3	SAMPLE TYPE	SAK	띭	SUBFACE EL EVATIO	N			foot	0 5	10	15	2	0 2	5
<u> </u>	-		111	111	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1					<u> </u>		1 1		<u> </u>	
	1	ss	Ш	111	1				16						
			ĺ							}i					.
	1									j					
5.3	\vdash	 	111	1	7	wm - moist - medium dense - (S)	4) - (fil	11)							
	2	SS			- (no creosote o	odor)			28	7					
	Г	Ī	Γ	Ī				Ī							
	1														
==	<u> </u>	<u> </u>	<u> </u>	<u> </u>											<u> </u>
10.3	3	SS	III	H					13						
	-	133	뱉	111		and, trace gravel and silt - br				F					
	ł		1		sacuraced - medi	um dense - (SP-SM) - (no creoso	ota odor,	,		.				}	
				l										ł	
15.0	=	<u> </u>	<u> </u>	-						1					
	4	SS	Ш	Ш	}				11					ł	
=	_	 	i"			race silt - grayish brown - sat	uraced -	-		li l		ļ			
	1				medium dense - (SW) - (no creosota odor)								ĺ	
	}			ĺ						1 1					
20.0			╁	h						<u>!</u>				 -	
	5	SS	Ш	Г	1	ace silt - brown - saturated -	medium		11			i i			
				١	dense - (GP) - (no creosote odor)				H 1					
		_		┞		····						-	•	<u> </u>	
25.0						-		1							
	6	ss	Ш	\coprod		te sand, trace gravel - gray -	(CL) -		15						
	 		111		(glacial till) -	· (no creosote odor)		1						İ	
			İ	T						1		İ			1
30.3	<u> </u>	 	Ш	П	Note: Jected wi	th fresh water before taking sa	mple #7	to							
	7	SS	Ш		remove sa	nd which heaved up into augers.			9	3					
					5			- 1		lı		1		}	
						and, trace silt - brown - satur dense (SP) - no creosote odor								1	
<u> </u>					·	, ,									
	8	SS		Ш				Ì	13					ĺ	
36.0	 	\vdash	۳	\vdash										 	<u></u>
					End of boring at	: 36.0 ft. ' hollow stem augers to full dep	5								
						noilow stem augers to full dep with neat cement grout, tremied		l							
					of drilled hole.]			
								ļ							
=	l							}							1
								Ì							1
														!	
								1							
		TITE	511	101	IFICATION LINES DEDDECT!	T THE APPROXIMATE BOUNDARY LINES BETWE	EM CON TYP			THE TOAL	SITION	MAYES	ימונומי		·
WL	===	11112		-/11			EN SUIL TYP				SHUN	WAT BE C	,,,,oo,,(-	
	Not	tak	en		WS OR WU	BORING STARTED 9/23	3/88	SIS	OFFICE	Mi	nneso	ta			
WL				В	OR ACR	BOHING COMPLETED		DRAV	WN BY			ETNO.	OF		Į.
.v						FIGEOREMAN	1/88	APP'I	. 	КС		JOB NO.	1		-
						D-10	981	, ree l	., ., ,	מר.ד	131.3	.,	ባ ኒ፣	171-	

9/23/88

RIGFOREMAN 0-50

APPENDIX C

QUALITY ASSURANCE PROJECT PLAN

This Appendix contains 55 pages.

Page: 1 of 46 Date: June, 1988 Number: QAII.I Revision: 1

QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN
NEAR SURFACE CONTAMINATION
CONSENT DECREE - REMEDIAL ACTION PLAN
SECTION 11

Prepared for The City of St. Louis Park St. Louis Park. MN 55416

APPROVED BY: Jugania M. Lee	DATE: 10 - 28-87
S. LEE/DIVISION QUALITY CONTROL MANAGER INTERPOLL. INC.	
APPROVED BY: Former Alledithen?	DATE: 10-76-87
JAMES H. OVERTOOM/GEOTECHNICAL SAMPLING & STS CONSULTANTS. INC.	ANALYSIS PROJECT MANAGER
APPROVED BY: Richard L. Koppy	DATE: 10-27-87
RICHARD L. KOPPY/PROJECT COORDINATOR WESTWOOD PLANNING & ENGINEERING COMPANY	
APPROVED BY: James of Grube	DATE: 10/27/87
JAMES N. GRUBE/PROJECT MANAGER CITY OF ST. LOUIS PARK, MN	·
APPROVED BY:	DATE:
ANDREA JIRKA/QUALITY ASSURANCE OFFICER USEPA REGION 5	
APPROVED BY:	DATE:
ERIN MORAN/REMEDIAL PROJECT MANAGER	

UESPA REGION 5

Page: 1 of 46 Date: October, 1987

Number: QAll.1 Revision: O

QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN
NEAR SURFACE CONTAMINATION
CONSENT DECREE - REMEDIAL ACTION PLAN
SECTION 11

Prepared for The City of St. Louis Park St. Louis Park. MN 55416

APPROVED BY: uzanni The Lee	DATE: 10 - 28-87
S. LEE/DIVISION QUALITY CONTROL MANAGER INTERPOLL. INC.	
APPROVED BY: Jamet Martin	DATE: 10-78-17
JAMES H. OVERTOOM/GEOTECHNICAL SAMPLING & STS CONSULTANTS. INC.	ANALYSIS PROJECT MANAGER
APPROVED BY: Richard L. Koppy	DATE: 10-27-87
RICHARD L. KOPPY/PROJECT COORDINATOR WESTWOOD PLANNING & ENGINEERING COMPANY	
APPROVED BY: James M. Lhube.	DATE: 10/27/87
JAMES N. GRUBE/PROJECT MANAGER CITY OF ST. LOUIS PARK, MN	
APPROVED BY:	DATE:
JAMES ADAMS/QUALITY ASSURANCE OFFICE USEPA REGION 5	
APPROVED BY:	DATE:
ERIN MORAN/REMEDIAL PROJECT MANAGER	

UESPA REGION 5

Page: 2 of 46
Date: June, 1988
Number: QAll.1
Revision: 1

QUALITY ASSURANCE PROJECT PLAN

TABLE OF CONTENTS

l .	TITLE PAGE	PAGE
		-
2.	TABLE OF CONTENTS/LIST OF FIGURES	2
3.	PROJECT DESCRIPTION	5
	3.1 Background 3.2 Project Objectives 3.3 Time Schedule 3.4 Intended Data Usage 3.5 Sampling Network and Rationale 3.6 Sample Matrices, Parameters and Frequency	5 7 7 7 7
4.	PROJECT ORGANIZATION AND RESPONSIBILTIES	8
5.	QUALITY ASSURANCE OBJECTIVES	10
	5.1 Data Quality Objectives 5.1.1 Accuracy 5.1.2 Precision 5.1.3 Sensitivity 5.1.4 Completeness	11 11 11 11
6.	SAMPLING PROCEDURES	12
	6.1 Training6.2 Document Control6.3 Sample Control procedures and Chain of Custody	12 12 12
	6.3.1 Sample Identification6.3.2 Chain of Custody Procedures6.3.3 Field Forms	13 13 16
	6.4 Sampling Procedures	16
	6.5 Field Measurement Equipment	15
	6.6 Duplicate Samples	16
7.	SAMPLE CUSTODY	17
	7.1 Chain-of-Custody7.2 Recordkeeping7.3 Final Evidence Files	17 17 19

Page: 3 of 46
Date: Sept., 1988
Number: QAll.1
Revision: 1

8.	CALIBRATED PROCEDURES	24
	8.1 Analysis of phenolics 8.2 Analysis of Benzene Extractables 8.3 Field Measurement Equipment 8.3.1 HNU Photoionization Detector 8.3.2 Biosnesor II Combustible Gas indicator	24 24 24 24 24
9.	ANALYTICAL PROCEDURES	25
	9.1 Analysis of Phenolics and Benzene Extractables	25
	9.1.1 Summary 9.1.2 Benzene Extractables - EPA Method 9071 I 9.1.3 Phenolics - EPA Method 9065 I	25 25 29
10.	DATA REDUCTION, VALIDATION AND REPORTING	33
	10.1 Data Reduction and Validation 10.2 Calculations 10.3 Turnaround . 10.4 Analytical Results Report	33 33 33 33
11.	INTERNAL QUALITY CONTROL CHECK	34
	<pre>11.1.1 Benzene Extractable and Phenolics 11.1.2 Duplicate</pre>	34 34
12.	PERFORMANCE AND SYSTEMS AUDITS	35
	12.1 Inter-Laboratory Performance Surveys 12.2 Periodic In-House Audits	35 35
	12.2.1 Performance Audits 12.2.2 Systems Audits	36 37
13.	PREVENTATIVE MAINTENANCE	40
	13.1 Service Contracts 13.2 Instrument Logbooks 13.3 Field Measurement Equipment	40 40 40
14.	SPECIFIC PROCEDURES TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS	41
	14.1 External and Internal Components	41
	14.1.1 External Components: Accuracy and Precision Measurements 14.1.2 Internal Components: Accuracy and Precision Measurements	41 41
	14.2 Control Charts	42
	14.2.1 Accuracy 14.2.2 Precision	42 42 43

Page: 3.A of 46
Date: June, 1988
Number: QAll.1
Revision: 1

14.3	Suspici	Lons/Out-of-Control Events	43
	14.3.1	Outliers	43
	14.3.2	Runs	43
		Trends	43
		Periodicity	43
14.4	Accepta	ance Criteria	43
	14.4.1	Accuracy	43
	14-4-2	Precision	43A
	14-4-3	Sensitivity	43A
	14.4.4	Completeness	43A
15. CORRE	ECTIVE AC	CTION	44
15.1.	l Matri	ix Spikes	44
15.1.	2 Dupli	icate Analysis	44
15.2	Project	Specific Out of Control Criteria	44
	15-2-1	Accuracy	44
	15.2.1	Precision	44
15.3	Accurac	cy and Precision Review	44
16. QUAL	TY ASSUR	RANCE REPORTS TO MANAGEMENT	46
16.1	Performa	ance and Systems Audits	46
ADDENNIY	A - STAN	NDARD OPERATING PROCEDURES	

Page: 4 of 46
Date: June, 1988
Number: QAll.1
Revision: 1

QUALITY ASSURANCE PROJECT PLAN

LIST OF FIGURES

3-1	Location Map	Page 6
3-2	Preliminary Schedule for Soil Boring & Soil Analyis	7 A
4-1	Organization Chart	9
6-l	Chain of Custody Record (Sampling	14
6-2·	Chain of Custody Record (Analytic)	15
7-1	Forms Distribution Summary	20
7-2	Out of Control Events Log	21
7-3	Analytical Method QC Checklist	22 .
7-4	Precision/Accuracy Report	23
15~1	Out of Control Events Log	45

Page: 5 of 46

Date: October, 1987

Number: QA11.1 Revision: 0

QUALITY ASSURANCE PROJECT PLAN

3. PROJECT DESCRIPTION

3.1 Background

The purpose of this Work Plan is to carry out a near-surface soils investigation on properties south of West Lake Street, east of Taft Avenue, west of Monitor Avenue and north of Minnehaha Creek (Figure 3-1). This investigation will be carried out in accordance with Section 11.1 of the CD-RAP. The purpose of this soil investigation is to determine the extent of subsurface contamination south of the Reilly Site.

The area shown on Figure 1, constitutes approximately 300 acres of commercial-industrial property in St. Louis Park. Generally, the land slopes north to south toward Minnehaha Creek and contains numerous commercial and industrial building structures, parking lots, and streets. Most of the developments that occurred in this area originated in the late 1940s and 1950s. Gordon Sash & Door Company and Cardinal Glass Company were a singular business during the 1960s. A division of these two businesses occurred in the early 1070s. Later, during 1979 and 1980. land was acquired and Louisiana Avenue was constructed between the two properties. Methodist Hospital occupies the largest land holding in the area of any of the properties. Established in 1948, the hospital corporation controls approximately 140 acres of property within the study area.

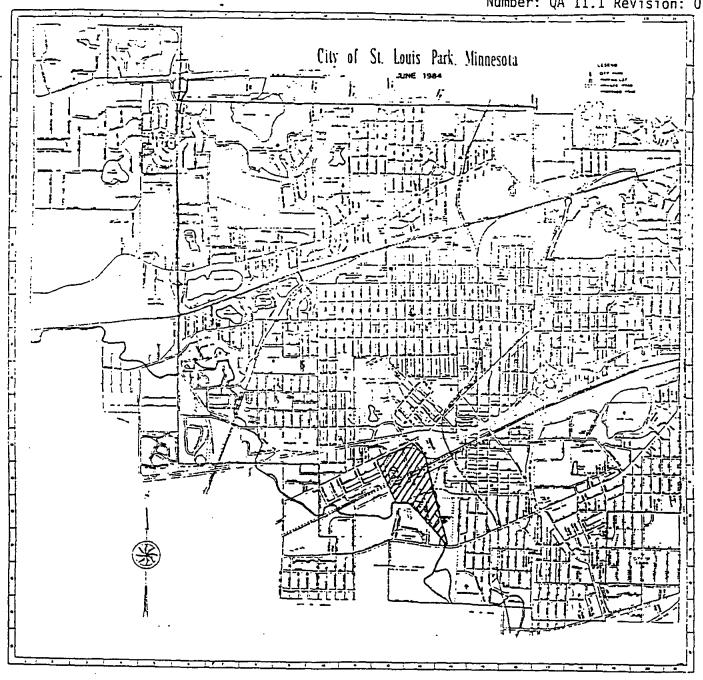
STS Consultants, Ltd. (STS), Interpoll Laboratories (Interpoll) and the City of St. Louis Park (City) will complete certain tasks in fulfillment of the Consent Decree and Remedial Action Plan (CD-RAP) Section 11 "Near Surface Contamination". This Quality Assurance Project Plan pertains to all work to be performed by STS. Interpoll and the City in completing the requirements of Section 11.1 of the RAP. This work will involve the drilling of subsurface exploration borings extending to depths of at least 35 feet and possibly to the bedrock (estimated to be at a depth of approximately 100 feet) based upon the observations of the geologist, the sampling of soils, and the testing of selected soil samples for benzene extractable compounds and/or phenolics.

3.2 Project Objectives

The purpose of this Quality Assurance Project Plan is to define the Quality Assurance and Quality Control provisions to be implemented such that:

- o The resulting soil borings, sampling and analysis conform to the procedures given in the Site Management Plan.
- o The work is performed in an efficient manner.
- O Records generated during the course of the field work and laboratory testing are sufficiently complete and accurate to satisfy data analysis and report requirements.
- All assumptions, interpretations and analyses used in the process of deriving reported results and conclusions shall be documented in permanent records.

Page 6 of 46 Date: Oct, 1987 Number: QA 11.1 Revision: O



THE PARTY													
	1-43												
*****		*		-	84)		* *						
	Ξ:		po 1	-			T. :		4+44	12-1-2 140	2+10	T	
	2;	-				Personal lane	<u></u>		C-18	the trees	t-10	**********	
				-	J-ta		B-10		9-10	less from	1.11		F 1
		******	- *		de i	Personal Park		~~~~		Marcel Pro-	Ü.,		
		<u>~~~</u>	t- 1		6003	Parameter A	200		A.s	Had beens	T:		
	- :	7-1			i-12		616		** *	Parent Marie	L-10		
	1-08 In 8	Post Clarks	- 1	terrorem there	0-14		1-14		N 1	Her laren		الاستهد	
==	2:		- 1	1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-					~~	Mai: 6 24v-	744		****
==		~		1000 married	Bria.				h-m	Hote Mema			beta
			P-40			<u></u>	<u></u>		p				-
		~	P-10		Pro. 6		P-10	-	6 14	~ ***			
		*****					6-68		1 -14		***		Ξ:
-		Property and address	t-11		=						2-14		
		Printer or and		-					-			700 000	jest g Jest S
-									1-10	** ****			
·		-				-		total commu			4-49		
*******	L3	-		===	Brits Press	-	-	=		10-1/5 Wyang	0-10	·	
terr run			£:		-	-			1-10				
				*****				`					
	***			There (12 a s	1-40	-	1-01						
		Ca Car		The same of the same of	• •	-			Bert B	ind.		CONTRACTOR	
f	See 1				L 1		P-14	·	Ξ:			(110 ma)	N-1.0
			P+13		-	سے جارہ جے	~~				. .	-	214
	last.		141			****	- ·	L	L-11		Litt		
	B-43						A	Am 4		N		Marie - Control	
	P-75		m1			-	11.30	170	****		tes t		4-15
-	A-se			*****			10.7	Ind'I been	£-10	trens	141		
Chie term	A	~	4.4				-		****	Married o	***	<u> </u>	
	E	~		~~~	1	1-71	-12	100 000	€-+1	Sec. 17.1	4012		
				77	F-1	l	1119	101 100	e				****
	10. 0		***	-	E.;	free fame many	to s				Int I	~	**:*
	— 1	~ <i>'</i> '	Lote		~ 3	Perm - 1884	D-15		Man '	Landrana	bet 1	u	F-4)
	Ξ:	~~~				lei en ener	1-17	124	~ •	fere 744	1:10		
					L.			// terms	* •	10.11.			
		'	F-13		A.11	F		, 	****	lam es			
 -	p-en	·	- •		4-14		2:		C-11				
-		,	1-0	***	***		Z.,	Non-rem	. ,	**********			
	J. 1						-17	***		*****	-:		
	2;	·	P-12						~	*****			
		A			\$-r4	· ·		~~					
************************					****			Pro treas	4-+1		****		
		****	6.1	***			2010	Care division		*** **** ****			
	P+11				- .,	***************************************	A-14	-	1482	*******	****		
		·	p-12				1- 1	Mari / Haraya		**	****		
			E.				- ·	70	1.11		b -11		
				******* - ***	4-11	******* *		-	tet I				

FIGURE 3-1 - LOCATION MAP

Page: 7 of 46
Date: June, 1988
Number: QAll.1

1

Révision:

3.3 Time Schedule

In accordance with the contents of the Remedial Action Plan (RAP), Section II.1.2, the drilling activities will take place within 90 days of receipt of approval of the plan by the USEPA and MPCA, or within a different time frame upon mutual agreement of the Agencies, Reilly, and City. Within 60 days of completing installation of borings, the City shall submit to the USEPA and MPCA a report on the results of the borings.

Figure 3-2 presents the schedule currently planned for the installation and sampling of the borings. This schedule is subject to modification as the work progresses, and the City makes no commitments to meeting any of the schedule dates other than the comletion/submittal requirements specified in the RAP.

3.4 Intended Data Usage

The qualitative descriptions of certin soil samples in this study shall be used to interpret whether samples are containinated. The City shall coordinate an effort to notify the Parties to the CD-RAP owning property in the study area on which a relese of hazardous substances resulting from operations at the Site has occurred or is occurring through the filing of affadavits with the Recorder of Deeds of Hennepin County pursuant to Minnesota Statutes 1158.16, Subdivision 2 (984) within 180 days of completion of the borings. In addition, the City will submit a list of owners and locations of the properties on or under which a release of hazardous substances has occurred or continues to occur.

3.5 Sampling Network and Rationale

The Work Plan specifies the location of the intial 15 borings. These sampling locations have been defined utilizing the following three criteria:

- 1. Coverage of a variety of properties the study area constitutes approximately 300 acres of land in St. Louis Park. Soil borings have been proposed over 15 independently owned properties. Refer to Exhibit A of the Soil Investigation Plan for the locations of the borings.
- Areal coverage maximized -- in addition to studying as many properties as
 is possible, the soil boring locations have been proposed to cover as
 large an area as possible.
- 3. Ease of access to the boring location in order to use the funds for this study in a cost effective manner reasonable acces with the drilling equipment for each boring location has been sought.

3.6 Sample Matrices, Parameters and Frequency

Section II.1 of the explicitly states that soils must be analysed for benzene extractables and/or Phenolics. Accordingly, for puposes of this Plan, the sample matrix shall simply be described as soil. No distinction of soil types is offered, however, during the course of the investigation all soil types encountered shall be reported.

Page: 7A of 46 Date: June, 1988 Number: QAll.1 Revision: 1

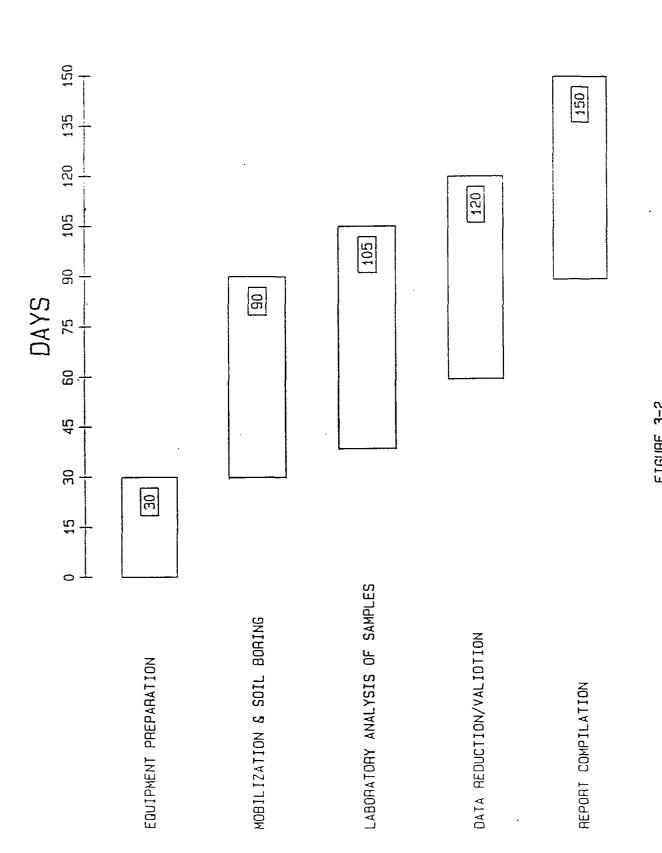


FIGURE 3-2 PRELIMINARY SCHEDULE FOR SOIL BORING & SAMPLE ANALYSIS

での発

The state of the s

à.,

Page: 7B of 46 Date: June, 1988 Number: QA11.1 Revision: 1

Each soil matrix retrieved for analysis shall be analyzed for benzene extractables and/or phenolics only. The frequency of sample retrieval/analysis, as established in the CD-RAP, is one time only. No repetition of sampling is contemplated unless the resampling constitutes one of the 15 to 25 borings and one of the 15 to 45 analyses.

Page: 8 of 46

Date: October, 1987 Number: QAll.1 Revision: O

PROJECT ORGANIZATION AND RESPONSIBILITIES

The parties to the CD-RAP include the USEPA, MPCA, Reilly, and the City. The project organization shown in Figure 4-1 indicate the involvement of the properties. Responsibilities of the key positions in the project organization are as follows:

City Project Manager

Coordination of the implementation of all phases of the CD-RAP for which the City is responsible.

Coordinating Geologist

Coordination of data compilation of all phases of the CD-RAP and evaluation of data as it relates to the various CD-RAP requirements.

Project Coordinator

Coordination of geotechnical sampling and chemical analysis and report development for submittal to the paties of the CD-RAP

Geotechnical Sampling and Analysis Project Manager Coordination of field sampling and sample submittal to the laboratory for analysis and review of data/reports for completeness

Geotechnical Sampling Geologist

Oversight of field work and sample retrieval and soil classification

Chemical Analysis Laboratory Director Responsible for overall management of operations including review of analytic reports developed on the project

Inorganic Chemistry Lab Manager Managemnt of inorganic chemistry laboratory including scheduling of personnel and physical resources.

Quality Control Manager

Responsible for overall quality control oversight, including performance and system audits.

Quality Control Coordinator Responsible for maintaining the laboratory Quality Control program. Maintains laboratory standards and traceability documentation and performs analytical data package validation.

Page: 9 of 46

LAB MANAGER

ANALYST

G. Holman

TECHNICIAN

Date: October, 1987

Number: QA11.1

PROJECT ORGANIZATION CHART - FIGURE 4-1

Revision: 0 EPA MPCA PROJECT MANAGER PROJECT MANAGER M. Vennewitz Erin Moran CITY OF ST. LOUIS PARK PROJECT MANAGER J. Grube COORDINATING GEOLOGIST PROJECT COORDINATOR GEOTECHNICAL SAMPLING AND ANALYSIS PROJECT MANAGER -W. M. Gregg R. L. Koppy J. H. Overtoom GEOTECHNICAL SAMPLING CHAMICAL ANALYSIS **GEOLOGIST** LABORATORY DIRECTOR D. Johnston R. Dahl DIVISION QUALITY CONTROL INORGANIC CHEMISTRY Driller

MANAGER

S. Lee

LABORATORY QUALITY CONTROL

COORDINATOR

L. Graff

Page: 10 of 46
Date: June, 1988
Number: QAll.1
Revision: 1

5. QUALITY ASSURANCE OBJECTIVES

The principal objectives of this Plan pertain to the collection of data that are sufficient to determine the absence or presence of soil contamination above normal background levels for phenolics and benzene extractables. The CD-RAP defines Contamination as "PAH and Phenolics resulting from activities of Reilly at the (former coal tar refinery and wood treating) Site when found in the groundwater or the soil." The first criterian that will be used to defined contamination is visual observation. This qualitive criteria is appropriate because the types of contaminants associated with Reilly's activities often produce a dark stain or discoloration of the soil. The presence of odors and organic vapors detected with the organic vapor detector/analyzer will supplement the visual discriptions of contamination. Pages 13 through 18 of the Site Management Plan provide greater detail relative to the defination of background levels, contamination, etc.

The quality of the data gathered in this project can be defined in terms of the following elements:

- a. Completeness a sufficient number of successfull (valid) measurements to characterize the concentrations of phenols and benzene extractables in St. Louis Park sampling sites.
- b. Representativeness the extent to which reported analytical results truly depict the phenolic and benzene extractable concentrations in the sampled environment. Representativeness is optimized through proper selection of sampling sites, through proper sample preservation, and through prompt analysis.
- c. Accuracy and Precision accurate and precise data will be achieved through the use of sampling and analytical procedures that minimize biases, through the use of standard procedures, through the meticulous calibration of analytical equipment and by implementing corrective action whenever measured accuracy and precision exceed pre-established limits. Accuracy and precision will be measured by the analysis of method spikes and duplicate samples.
- d. Sensitivity determination of instrument sensitivity is accomplished by calibration using multiple concentrations of the analytes of interest. Once instrument sensitivity is demonstrated, analysis of duplicate spiked samples of deionized reagent water at a concentration of 1-5 times the instrument sensitivity is used to determine method sensitivity (i.e., method detection limit).
- e. Comparability the extent to which comparisons among separate measurements will yield valid conclusions. Comparability among measurements in the SLP monitoring program will be achieved through the use of rigorous standard sampling and analytical procedures.
- f. Traceability the extent to which results can be substantiated by hard-copy documentation. Traceability documentation exists in two forms: That which links final numerical results to authoritative measurement standards, and that which explicitly describes the history of each sample from collection to analysis.

Page: 11 of 46 Date: June, 1988 Number: QAll.1 Revision: 1

The mechanisms that will be employed to achieve these quality goals are categorized as prevention, assessment and correction, as follows

- a. Prevention of defects in the quality through planning and design, documented instructions and procedures, and careful selection and training of skilled, qualified personnel.
- b. Quality assessment through a program of regular audits and inspections to supplement continual informal review.
- c. Permanent correction of conditions adverse to quality through a closedloop corrective action system

The Quality Assurance objectives will include method blanks, field duplicates and matrix spikes. Precision, accuracy and completeness criteria are established for each parameter of interest. The specific criteria for each analysis and parameter are set forth in detail in the following sections:

Objectives	Frequency
Field Duplicates	10%
Method Blanks	5%
Matrix Spikes	5%

5.1 Data Quality Objectives

5.1.1 Accuracy

The required analyte recovery for both phenolic and benzene extracted spiked samples shall be a minimum of 50% and a maximum of 180%.

5.1.2 Precision

The required reproducibility on split sample analysis for both phenolics and benzene extractables shall be a relative percent difference no greater than 50%.

5-1.3 Sensitivity

Required detection limit for benzene extractables shall be 500 mg/kg, and 1 mg/kg for phenolics.

5.1.4 Completeness

90% of analytical data shall me the above criteria for accuracy, precision and sensitivity.

Page: 12 of 46

Date: October, 1987 Number: OA11.1

Number: QA11. Revision: O

SAMPLING PROCEDURES

Soil samples will be collected by STS Consultants, Ltd. (STS) personnel. This section discusses general OAPP provisions relevant to sample collection, containerazation, packaging and shipping activities.

6.1. Training

All personnel working on the project will be properly trained, qualified individuals. Prior to commencement of work, personnel will be given instruction specific to this project, covering the following areas:

- * Organization and lines of communication and authority
- * Overview of the Site Management Plan and QA Project Plan
- * Documentation requirements
- * Health and Safety considerations

Training of field personnel will be provided by the Geotechnical Sampling Geologist. Analysts performing chemical analyses of samples will be trained in and will have exhibited proficiency in the analytical methods to be imployed.

6.2. Document Control

Document control for this Plan serves a two fold purpose insuring that:

- * All participants in the project are promptly informed of reevisions of the OA Project Plan
- * All documents generated during the course of the program are accounted for during, and at the end of the project.

Each page shall contain the following information:

- * Document number
- * Page number
- * Total number of pages in document
- Revision number
- Revision date

When any documents are revised, the affected pages are reissued to all personnel listed as document holders with updated revision number and dates. Issuance of a revision is accompanied by explicit instruction as to which documents or portions of documents have become obsolete.

6.3. Sample Control Procedures and Chain or Custody

In addition to proper sample collection, preservation, storage and handling, appropriate sample identification procedures and chain of custody are neessary to help insure the validity of the data.

Page: 13 of 46

Data: October, 1987 Number: QAll.1 Revision: O

6.3.1 Sample Identification

Sample labels shall be completed for each sample, using waterproof ink, unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample tag because a ballpoint pen would not function in freezing weather. The information recorded on the sample label shall be formated as follows:

XX - YYYY-ZZZZ

XX - Boring Number

YYYY - Depth of sample

ZZZZ - Method of sample retrieval

Remarks = Any pertinent observations or further sample description.

6.3.2 Chain-of-Custody Procedures

To maintain and document sample possesion, chain-of-custody procedures will be followed: A sample is under custody if:

* It is in someone's possession, or

* It is in someone's view, after being in their possession, or

* It was in someone's possession and they locked it up to prevent tampering, or

* It is in a designated secure area.

TRANSFER OF CUSTODY AND SHIPMENT

- 1. Samples are accomplanied by a Chain-of-Custody Record, both during the sampling stage (Figure 6-1 and analytic stage Figure 6-2). When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time of the record. This record documents sample custody transfer from the sampler, often through another person, to the analyst at the laboratory.
- 2. Minimum information recorded on the chain-of-custody record in addition to the signatures and dates of all custodians will include:
 - Sampling site identification
 - * Sampling date and time
 - * Identification of sample collector
 - * Sample identifaction
 - * Sample description (type and quantity)
 - Analyses to be performed.
- 3. Samples will be packaged properly for shipment and dispatched to the appropriate laboratory for analysis, with a separate custody record accompanying each shipment. Shipping containers will be sealed for shipment to the laboratory.

ALTHUR SSUMME INVECT 明 一年 大 A CENTER

Date: October, 1987

TIME

DATE

6282

Samples Shipped Via

Number: QAll.Í Revision: O	CUSTODY RECORD
	4
	CHAIN
	FIELD
	\
	IDENTIFICATION
	SAMPLE

Sample	Samples Shipped Fron Samples Shipped To		Sealed for Shipment by ATTENTION OF	hipment by		
	STS Project Number			Project Chain Series	of Custody	y Record
					igno il	
Project Name / Description	uatt di		Name of Sampler(s)	/ Signa ture(s)		·
Sampling Date Time Point / Field ID Number	S liew gminotinom g liew gmitzixe d netaw eachine netawatzaw rbiloz etzaw nickieji etzaw i folioz etzaw	Sample Location	Analyses Required	Number Of Con- tainers	Comments on Samples (preserved, etc.)	mples Labora- tc.) tory ID #
Remarks on Site /	Site Conditions					
			·			
Samples Relinquished by		Samples Received by	Comments	5		Date / Time
Samples Relinquished by		Samples Received by	Comments	'n		Date / Time
Samples Relinguished by		Samples Received by	Comments	S		Dote / Time
Means of Delivery			Seal	Seals Intact: TYES	YES ND	N.A.
					1	

Original and yellow copies to lak. Pink copy for project file. Lab forwards completed original copy to STS with unalytical results, lab retains yellow copy. STS ENV 01 1-86

FIGURE 6-1 CHAIN OF CUSTODY RECORD (SAMPLING)

THAT IT'S ASSITERACE PRINTECT, PLAN

and the second

Interpoll Laboratories

....Paçat...15 at.46 Date: October, 198/ Number: QA11.1 Revision: 0

SAMPLERS: (Signature) Sample DATE DATE DATE DATE Sample DATE DATE Relinquished by: (Signature) PROJECT Sample DATE DATE Ballnquished by: (Signature) Relinquished by: (Signature)	CHAIN OF CON OF CON LOCATION TAINED IN LOCATION TAI	25 - 25	SAMPLE TYPE (V) ERS A- A- A- A- A- A- A- A- BRS A- BRITHQUISHED BY (Stgnature)	SAMPLE SAMPLE dulshed by	ORD T T	TYPE (I/)	(E)	REN Date/Time	RKS Racelved by:(Signature)	ignature	
Relinquished by: (S/gnature) Date/Time	Received by:(Signature)		Relinquished by:(Signature)	Ished	by: (9	lana	ture)	Date/Time	Received by:(Signature)	(gnature)	1
Relinquished by: (Signature) Date/Time	Received for Laboratory by:	story by:		Date/Time	e E	E E	Remarks:				

Distribution Original Accompanies Shipment, Copy to Coordinator Field Files

200

Page: 16 of 46 Date: Sept., 1988 Number: QAll.1 Revision: 2

4. Whenever samples are split with another laboratory, it is noted in the "Remarks" section. The note indicates with whom the samples are being split and is signed by both the sampler and recipient. If either party refuses a split sample, this will be noted and signed by both parties. The person relinquishing the samples to the facility or agency should request the signature of a representative of the appropriate party, acknowledging receipt of thee samples. If a representative is unavailable or refuses to sign, this is noted in the "Remarks" space. When appropriate, as in the case where the representative is unavailable, the custody record should contain a statement that the samples were delivered to the designated location at the designated time.

6.3.3 Field Forms

In addition to sample labels and chain-of-custody forms, a bound field notebook will be maintained by the sample team leader to provide a daily record or significant events. All entries will be signed and dated. All members of the sampling team will use this notebook. The notebook will be kept as a permanent record.

6.4. Sampling Procedures

For this study, background levels of benzene extractable hydrocarbons will be determined by testing a maximum of 10 samples classified by the sence of smell as "clean". The City's representative will be responsible for designating at lease one sample retrieved from each soil boring for laboratory analysis for benzene extractable hydrocarbons. Accordingly, at least 25 samples will be analyzed during the initial round of sampling. In the event up to 10 additional soil borings are undertaken in a follow-up round, at least one sample will be returned from each boring, up to a total of 20 samples, and all samples will be analyzed for benzene extractable hydrocarbons.

Soil samples, weighing, at least 200 grams will be obtained using the split-barrel sampling procedure in general conformance with ASTM Specification D-1586-84. The geologist will take possession of the split-barrel sampler immediately upon its emergence from the borehole, prepare all soil samples for laboratory analysis, and classify the samples in m.l. wide mouth clear glass sample containers fitted with aluminum foil lined caps. All samples shall be packed, cooled to a temperature less than 4 C and shipped to the analytical laboratory on the same day.

A new pair of disposable latex gloves will be used for each sampling site. Between sites, and between each use of the split-barrel sampler, sampling equipment will be steam cleaned or washed with soap (trisodium phosphate) and potable water.

Steam cleaning is required whenever separate phase hydrocarbons are encountered, and is the perferred cleaning method. Soap and water cleaning may be used in lieu of steam cleaning provided that the cleanest available equipment (e.g., split spoons) are used and that the method is effective in removing all dirt from the equipment. Following soap and water cleaning, the sampling equipment will be rinsed with methenol, hexane, methanol, air dried in a contaminant free area, then rinsed with potable water prior to reuse.

Page: 16.A of 46 Date: Sept., 1988 Number: QAll.1 Revision: 2

6.5. Field Measurement Equipment

All field measurement equipment will be controlled in accordance with manufacturer's specifications to ensure that measurements obtained are accurate and defensible. Specific field measurement equipment shall include an HNU Photoionization Detector.

6.6. Duplicate Samples

Duplicate samples will be collected by splitting the sample longitudinally with a stainless steel knife, and each half will be placed in separate sample jars.

Page: 17 of 46 Date: June, 1988 Number: QAll.1 Revision: 1

7. SAMPLE CUSTODY

Interpol! operates under a formal quality control program. The Chain-of-Custody (Figure 6-2) contains two major elements: The field sampling, and the laboratory custody. Section 6.3 discusses the field sampling aspects. This section covers quality related activities applicable to the St. Louis Park Soil Study from the receipt of samples at the laboratory through the issuance of validated analytical data and the storage of data in the final evidence file.

7.1 Chain-of-Custody

When samples are received into the laboratory, the Sample Custodian will verify their integrity as they are unpacked and will explicitly state in the log-in records whether the sample is received intact or broken and whether the sample is appropriately identified. If the integrity requirements are met, or when any discrepancies are resolved, Interpoll assigns the sample a laboratory control number, stores the samples in a refrigerator and enters the pertinent information into the sample log.

7.2 Recordkeeping

In addition to sample chain-of-custody, the laboratory will maintain the necessary documentation to reconstruct the entire process of sample preparation through analysis and report generation. This documentation is found in logbooks, data packages.

The data package contains only data pertinent to the individual project. This package is filed alphabetically by project and date and includes the following records:

- a. Forms Distribution Summary a form which lists the contents of the Data Package and routes the data review process (Figure 7-1).
- b. Out-of-Control Events Log a form which describes any out-of-control events which may affect the quality of data to be reported and explains the causes and corrective actions taken (Figure 7-2).
- c. Analytical method QC Checklist on this sheet one records pertinent information from duplicate and spiked samples, method blanks and performance standards (Figures 7-3 and 7-4).

In addition to these forms, a Data Package will contain other pertinent information, such as daily instrument calibration, check standard results, chromatographic charts, computer printouts, references to other logbook entries and correspondence.

Page: 18 of 46 Date: June, 1988 Number: QAll.1 Revisions: 1

"THIS PAGE INTENTIONALLY LEFT BLANK"

では

Page: 19 of 46

Date: October, 1987 Number: QAll.1 Revision: O

7.3 Final Evidence Files

All data files generated on the project shall be maintained in a final evidence file by Interpoll for a period of two years. The file storage area shall be locked and access will be limited to authorized laboratory personnel.

The City shall be the final, utlimate repository of data generated on the project. Copies of all data will be maintained by the City for the life of the CD-RAP.

Interpol! Inc.

Page: 20 of 46 Date: June, 1988 Number: QA11.1 Revision: 1

Forms Distribution Summary

CLIENT: JOB:CLIENT NO:	
P.O. NO:	
PROJECT MGR:	
THUNE:	
CONTACT:Invoicing Signat	Report
ABORATORY REPORT #:	care Moderna
AMPLES COLLECTED: PL	7
SAMPLES RECEIVED: Lab Mgr	
InO Mgr	
DRS = "Data Reporting Sheet") Org Mgr	
<u>Inorganic</u> <u>Organic</u>	
LCI-17, Inorganic Area DRS LCI-05, VOA DRS	
LCI-17, Inorganic Area DRS LCI-05, VOA DRS (Fill out or add to corresponding LCI-06, PAH DRS	
form ECI-19) LCI-18, Phenols DRS	
LCI-28, PCB DRS	
Metals LCI-29, Pesticide/Herbi	icida NDC
LCI-34(3), MPCA Waste F	Profile DRS
LCI-35(1-4), EPA Method	1 625 DRS
LCI-04R, Metals DRS	
LCI-07R, E.P. Toxicity DRS GC/MS	
(Also fill out form LCI-37)	,
LCI-08R(3), EPA Waste Oil Profile DRS	
LCI-09R(1), ASTM Leach DRS LCI-13, Request for 6C/	/MS Analysis
LCI-15R, Mineral Ash DRS LCI-34(4), MPCA Waste Profile DRS Acid Rain	
LCI-34(4), MPCA Waste Profile DRS Acid Rain	-
LCI-36(1), Incineration Param. DRS	
LAR-01, Wet Deposition	
Fuel Metal Analysis DS	
LAR-02, Dry Deposition	_
Ammonium IC Analysis	>
LCI-02R, Fuel DRS LAR-03, Wet Deposition LCI-08R(I), EPA Waste Oil Profile DRS Cation Chromatograph	hy Shaat
-	
LCI-20, Fusion Temperature of Ash DRS LAR-04, Wet Deposition LCI-34(1), MPCA Waste Profile DRS Sample Prep, pH, Cor	
LCI-34(1), Arch waste Profile DRS	
cor ootzi, incineracion rangm. bro car-oo, ic anion anary:	د . د
Ion Chromatography Particle Sizing	
LCI-OBR(2), EPA Waste Oil Profile DRS LCI-25, Request for Par	rticle Size
LCI+09R(2), ASTH Leach DRS CCI 23, Request for Far LCI+09R(2), ASTH Leach DRS Analysis	
LCI-21, Ion Chromatography DRS LCI-26, Particle Size I	Distribution
LCI-34(2), MPCA Waste Profile DRS Analysis	
LCI-36(3), Incineration Param. DRSLCI-27, Combining Parts	icle Size Resu

Comments:

Page: 21 of 46
Date: June, 1988
Number: QAll.1
Revision: 1

Out of Control Events Log

Analyte	Method
Date	Units of Measurement
Nature of Out of Control Situation	
Dienseion•	
	•
•	
Action Taken:	
AnalystRe	eviewed by OCC
Dept. Mgr	CAM
	Lab Director

- Interpoll Laboratories

Page: 22 of 46
Date: June, 1988
Number: QAll.1
Revision: 1

Analytical Method QC Checklist

Project Nage:	Date:
Category:	Analyst:
Matrix:	Batch Numbers:
Prep Method #:	
Analytical Method %:	
Total Number of Samoles Analyzed:	
	na linete Va- Na
1. Values for all instrument blanks balow detect.	•
2. Reference standard analysis: Source	
<u>Analyte Theoretical Value Observ</u>	<u>ved Value</u> <u>Percent Recovery</u>
3. Matrix Spikes	
Number of sciked samples analyzed:	Average % Recovery:
	Range of % Recovery:
Recovery of each spike within control lis	mits: Yes No
4. Buolicates	
. Number of duplicate samples analyzed:	
Average Relative Percent Difference:	
Range of Relative Percent Difference:	· · ·
Precision for each set of duplicates with	hin control limits: Yes No
5. Method Blank	
Number of method blanks analyzed:	
All below detection limit: Yes	No
6. Calibration verified every samples.	
Compent::	

Page: 23 of 46 Date: June, 1988

Number: QAll.1

Interpoli Laboratories

Revision: 1

QC Data Report

[r:x:						/st:	····	
			Preci	isian Re	aart			
	İ			!	!		_	RELATI
55%*JE # .	mETHCD #	INSTRUMENT	ANALYTE	UNITS	INITIAL RESULT	DUPLICATE: RESULT	ABSOLUTE DIFFERENCE	PERCE DIFFERE
					ĺ			
-	1				1			1
	i i					1		İ
			-					!
	!				<u> </u>			<u> </u>
	<u> </u>	<u> </u>			!		<u> </u>	1
	!				<u> </u>			ļ
	1							<u>!</u>
	<u>!</u>				1			
	<u> </u>						<u> </u>	
	<u> </u>			<u> </u>	<u> </u>		<u> </u>	1
			A = -	0 -	-			
SAMPLE	METHOD		HLLI	racy Re	INITIAL	SPIKE	FINAL	PERCEN
#	#	INSTRUMENT	ANALYTE	UNITS	RESULT	EGNC.	RESULT	RECOVE
	<u> </u>					<u> </u>		
	!			<u> </u>				<u> </u>
		-		<u> </u>			(<u> </u>
	<u> </u>			<u> </u>			-	
	 	<u>'</u>		1			1	ii ii
	<u> </u>				<u> </u>	_		<u> </u>
•	<u>i</u>			<u> </u>	 		 	
·	1	1		<u> </u>	 		1	<u> </u>
	<u> </u>			 			1	1
	:	•		<u> </u>	<u>:</u>	- 	- 	11
	!			1	1	,	i	15

Page 24 of 46 Date: June, 1988 Number: QAll.1 Revision: 1

8. CALIBRATION PROCEDURES

8.1 Analysis of Phenolics

Prior to use of the method for analysis of phenols, a five-point response factor calibration curve is established showing the linear range of the analysis. Daily response factors or phenol are compared to the initial calibration curve. If the daily response factors are within +10 percent of the corresponding calibration curve value, the analysis may proceed. If, for any analyte, the daily response factor is not within +10 percent of the corresponding calibration curve value, a five-point calibration curve must be repeated prior to the analysis of samples.

8.2 Analysis of Benzene Extractables

Prior to use of the method of analysis of benzene extractables, an analytical balance, which is semi-annually calibrated under a service contract, is checked with class S weights to assure proper operation.

8.3 Field Measurement Equipment

8.3.1 HNU Photoionization Detector

The photoionization detector must be calibrated each day prior to field use. A calibration gas will be taken into the field to perform this routine calibration check. The procedure for the calibration of the HNU photoionization detector is listed in Standard Operating Procedures (SOP) STS-01, Appendix A to this Quality Assurance Project Plan.

8.3.2 Biosensor II Combustible Gas Indicator

The combustible gas indicator must be calibrated each week. The procedure for calibrating the Biosensor II combustible gas indicator is listed is SOP STS-02, Appendix A to this Quality Assurance Project Plan.

Page: 25 of 46 Dare: June, 1988 Number: QAll.1 Revision: 1

9. ANALYTICAL PROCEDURES

9.1 Analysis of Phenolics and Benzene Extractables

9.1.1 Summmary

Previously, the level of phenolic material in soil samples was measured on a 3 to 5 gram soil sample using the "Distillation Chloroform Extraction Procedure" contained on page 558 of "Standard Methods for the Examination of Water and Wastewater, 16th Edition." An April 20, 1970 memorandum to the Minnesota Pollution Control Agency from the Minnesota Department of Health concluded that this general method of phenolic determination was adequate to measure phenolics discharged in creosoting wastes from the Site, based on a limited amount of comparative testing carried out in the Health Department's laboratory. The detection limit for this phenolic analysis procedure was approximately 0.2 mg/kg (wet weight) when applied to the soil samples. Benzene extractable material was measured by extracting a 20 gram soil sample with benzene in a Soxhlet extraction apparatus for four hours and measuring the total weight of material extracted. Except for the use of benzene as the solvent, the analytical procedure used to measure the concentration of extractable material was the same as the Soxhlet extraction procedure given on page 412 of "Standard Methods for the Examination of Waste and Wastewaters 3th Edition." Extracted material was reported in milligrams of extracted material per kilogram of sample. The detection limit for the benzene extractable analyses was 50 mg/kg (wet weight).

To measure the concentration of phenolic material and benzene extractable material, a 100 gram sub-sample was taken from each soil sample and the sub-sample was quartered to obtain a 25 gram sample. Twenty grams of the quartered sub-sample were used in the analysis for benzene extractable material and 3 to 5 grams of the quartered sub-sample are used in the analysis of phenolic material.

To obtain the moisture content and, therefore, the dry weight of the soil sample, a quarter of the sub-sample was oven dried at 105 C to a constant weight. The loss of hydrocarbons by oven drying the samples at 105 C was defined by comparing the moisture content obtained by oven drying with the moisture content obtained by air drying.

9.1.2 Benzene Extractables

A. SCOPE AND APPLICATION

1. This method is used to recover benzene extractables by chemically drying a wet sludge sample and then extracting via the Soxhlet apparatus.

Page: 26 of 46

Date: October, 1987

Number: QA11.1
Revision: 0

B. SUMMARY OF METHOD

1. A 20 g sample of wet soil with a known dry-solids content is acidified to pH 2.0 with 0.3 mL concentrated HCL.

- 2. Magnesium sulfate monohydrate will combine with 75% of its own weight in water in forming $MsSO_4.7H_2O$ and is used to dry the acidified sludge sample.
- 3. After drying, the extractables are extracted with benzene using the Soxhlet apparatus.

C. INTERFERENCES

- 1. The method is entirely empirical, and duplicate results can be obtained only by strict adherence to all details of the processes.
- The rate and time of extraction in the Soxhlet apparatus must be exactly as directed because of varying solubilities of the extractables.
- The length of time required for drying and cooling extracted material must be constant.
- 4. A gradual increase in weight may result due to the absorption of oxygen: a gradual loss of weight may result due to volatilization.

D. APPARATUS AND MATERIALS

- 1. Extraction apparatus: Soxhlet.
- 2. Analytical balance.
- Vacuum pump or some other vacuum source.
- 4. Extraction thimble: Filter paper.
- 5. Glass wool or small glass beads to fill thimble.
- 6. Grease-free cotton: Extract nonabsorbent cotton with solvent.
- 7. Beaker: 150 mL.
- 8. pH Indicator to determine acidity.
- Procelain mortar.
- 10. Extraction flask: 150 mL
- 11. Distilling apparatus: Waterbath at 70 C.
- 12. Desiccator.

Page: 27 of 46

Date: October, 1987

Number: QA11.1 Revision: 0

E. REAGENTS

Concentrated hydrochloric acid (HCI).

- 2. Magnesium sulfate monohydrate: Prepare MgSO₄.H₂O by spreading a thin layer in a dish and drying in an oven at 150 C overnight.
- 3. Benzene: Boiling point, 80.1 C. The solvent should leave no measurable residue on evaporation; distill if necessary.
- 4. ASTM Type II water (ASTM D1193): Water should be monitored for impurities.

F. SAMPLE COLLECTION, PRESERVATION AND HANDLING

- 1. Transfers of the solvent benzene should <u>not</u> involve any plastic tubing in the assembly.
- 2. Sample transfer implements: Implements are required to transfer portions of solid, semi-solid, and liquid wastes from sample containers to laboratory glassware. Liquids may be transferred using a glass hypodermic syringe. Solids may be transferred using a spatula, spoon or coring device.
- Any turbidity or suspended solids in the extraction flask should be removed by filtering through greasefree cotton or glass wool.

G. PROCEDURE

- 1. Weigh out $20\pm~0.5$ g of sediment with a known drying solid content. Place in a 150 mL beaker.
- 2. Acidify to a pH of 2 with approximately 0.3 mL concentrated HC1.
- 3. Add 25 g prepared ${\rm MgSO_4H._2O}$ and stir to a smooth paste.
- 4. Spread paste on sides of beaker to facilitate evaporation. Let stand about 15-30 minutes or until substance is solidified.
- 5. Remove solids and grind to fine powder in a mortar.
- 6. Add the powder to the paper extraction thimble.
- 7. Wipe beaker and mortar with pieces of filter paper moistened with solvent and add to thimble.
- Fill thimble with glass wool (or glass beads).
- 9. Extract in Soxhlet apparatus using benzene at a rate of 20 cycles per hour for four hours.
- 10. Using grease-free cotton, filter the extract into a pre-weighed 250 ML boiling flask. Use gloves to avoid adding fingerprints to the flask.

Page: 28 of 46 Date: June, 1988 Number: QAll.1 Revision: 1

- 11. Rinse flask and cotton with solvent.
- 12. Evaporate the solvent by immersing the lower half of the flask in water of 90 C. A solvent blank should accompany each set of samples.
- 13. When the flask appears dry, remove. To remove solvent vapor, sweep out the flask for 15 seconds with air by inserting a glass tube that is connected to a vacuum source. Immediately remove the flask from the heat source and wipe the outside to remove excess moisture and fingerprints.
- 14. Cool the boiling flask in a desiccator for 30 minutes and weigh.
- 15. Calculate benzene extractables as a percentage of the total dry solids. Generally:

gain in weight of flask, g x 100
% of oil & grease = wt. of wet solids, g x dry solids fraction

H. QUALITY: CONTROL

- 1. Before processing any samples, the analyst should demonstrate through the analysis of Type II water method blank that all glassware is free of organic contamination; if there is a change in reagents, a method blank should be processed as a safeguard against reagent contamination. The blank sample should be carried through all stages of the sample preparation and measurement.
- 2. Standard quality assurance practices should be used with this method. Laboratory duplicates should be analyzed to validate the precision of the analysis. Fortified samples should be carried through all stages of sample preparation and measurement; they should be analyzed to validate the sensitivity and accuracy of the analysis.
- 3. Comprehensive quality control procedures are specified for each target compound in the referring analytical method.
- 4. All quality control data should be maintained and available for easy reference or inspection.
- 5. Employ a minimum of one blank per sample batch to determine if contamination has occurred.
- 6. Verify calibration with an independently prepared check standard every 15 samples.
- 7. Run one spike duplicate sample for every 10 samples. A duplicate sample is a sample brought through the whole sample preparation and analytical process (relative percent difference of greater than 50% is out of control).

Page: 29 of 46 Date: June, 1988 Number: QAll.1 Revision: 1

I. METHOD PREFORMANCE

1. No data provided.

J. REFERENCES

- 1. EPA Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Method 9071 (1986).
- 2. Blum, K.A. and M.J. Taras, "Determination of Emulsifying Oil in Industrial Wastewater", JWPCF Research Suppl., 40, R404 (1968).
- 3. Standard Methods for the Examination of Water and Wastewater, 16th ed., page 499.

9.1.3. Phenolics - EPA Method 9065 I

- A. SCOPE AND APPLICATION
- 1. This method is applicable to the analysis of sediments and soils.
- 2. The method is capable of measuring phenolic materials at the 0.2 mg/L level when the colored end product is extracted and concentrated in a solvent phase using phenol as a standard.
- 3. The method is capable of measuring phenolic materials that contain more than 50 ug/L in the aqueous phase (without solvent extraction) using phenol as a standard.
- 4. It is not possible to use this method to differentiate between different kinds of phenols.

B. SUMMARY OF METHOD

1. Phenolic materials react with 4-aminoantipyrine in the presence of potassium ferricyanide at a pH of 10 to form a stable reddish-brown antipyrine dye. The amount of color produced is a function of concentration of phenolic material.

C. INTERFERENCES

- Preliminary distillation is required to remove interfering materials.
- 2. Color response of phenolic materials with 4-aminoantipyrine is not the same for all compounds. Because phenolic-type wastes usually contain a variety of phenols, it is not possible to duplicate a mixture of phenols to be used as a standard. For this reason, phenol has been selected as a standard and any color produced by the reaction of other phenolic compounds is reported as phenol. This value will represent the minimum concentration of phenolic compounds present in the sample.
- 3. Interferences from sulfur compounds are eliminated by acidifying the sample to a pH <4 with H SO and aerating briefly by stirring.

Page: 30 of 46

Date: October, 1987

Number: QA11.1 Revision: 0

4. Oxidizing agents such as chlorine, detected by the liberation of iodine upon acidification in the presence of potassium iodide, are removed immediately after sampling by the addition of an excess of ferrous ammonium sulfate. If chlorine is not removed, the phenolic compounds may be partially oxidized and the results may be low.

D. APPARATUS AND MATERIALS

- 1. Distillation apparatus: All glass, consisting of a 1 liter Pyrex distilling apparatus with Graham condenser.
- 2. pH meter.
- 3. Spectrophotometer; For use at 460 or 510 nm.
- 4. Funnels.
- 5. Filter paper.
- 6. Membrane filteers.
- 7. Separatory funnels: 500 or 1,000 mL.
- 8. Nessler tubes: Short or long form.

E. REAGENTS

- ASTM Type II water (ASTM D1193): Water should be monitored for impurities.
- Sulfuric acid solution, H₂SO₄: Concentrated
- 3. Buffer solution: Dissolve 16.9 g NH $_4$ Cl in 143 mL concentrated NH $_4$ OH and dilute to 250 mL with Type II water. Two mL of buffer should adjust 100 mL of distillate to pH 10.
- 4. Aminoatipyrine solution: Dissolve 2 g of 4- aminoantipyrine (4- AAP) in type II water and dilute to 100 mL.
- 5. Potassium ferricyanide solution: Dissolve 8 g of $K_3Fe(CN)_6$ in Type II water and dilute to 100 mL.
- 6. Stock phenol solution: Dissolve 1.0 g phenol in freshly boiled and cooled Type II water and dilute to 1 liter (1 mL = 1 mg phenol).

Note: This solution is hydroscopic and toxic.

- 7. Working solution A: Dilute 10 mL stock phenol solution to 1 liter with Type II water (1 mL loug phenol).
- 8. Working solution B: Dilute 100 mL of working solution A to 1,000 mL with Type II water (1 mL = 1 ug phenol).

Page: 31 of 46

Date: October, 1987 Number: QAll.1 Revision: O

9. Chloroform.

10. Ferrous ammonium sulfate: Dissolve 1.1 g in 500 mL Type II water containing 1 mL concentrated $\rm H_2SO_4$ and dilute to 1 liter with freshly boiled and cooled Type II water.

F. PRESERVATION AND HANDLING

 Biological degradation is inhibited by the addition of H SO to pH <4. Store at 4^oC. The sample should be stable for 28 days.

G. PROCEDURE

1. Distillation:

- a. Measure 3 g of sample in a beaker. Lower the pH to approximately 4 with concentrated $\rm H_2SO_4$ (1 mL/L) and transfer to the distillation apparatus. Add 500 mL reagent grade water.
- b. Distill 450 mL of sample, stop the distillation and when boiling ceases, add 50 mL of warm Type II water to the flask and resume distillation until 500 mL have been collected.
- c. If the distillate is turbid, filter through a prewashed membrane filter.

2. Chloroform extraction method:

CAUTION: This method shuld be performed in a hood; chloroform is toxic.

a. Using working solution B (E.8.), prepare the following standards. Standards may be prepared by pipetting the required volumes into the separatory funnels and diluting to 500 mL with Type II water:

Working Solution B (mL)	Concentration (ug/L)
0.3	0.0
3.0	6.0
5.0	10.0
10.0	20.0
20.0	40.0
25.0	50.0

- b. Place 500 mL of distillate or an aliquot diluted to 500 mL in a separatory funnel. The sample should not contain more than 50 ug/L phenol.
- c. To sample and standards, add 10 mL of buffer solution (E.2.) and mix. The pH should be $10\pm~0.2$.
- d. Add 3.0 mL aminsatipyrine solution (E.3.) and mix.
- e. Add 3.0 mL potassium ferricyanide solution (E.4) and mix.

Page: 33 of 46
Date: June, 1988
Number: QAll.1
Revision: 1

10. DATA REDUCTION, VALIDATION AND REPORTING

10.1 Data Reduction and Validation

All data will be subjected to a rigorous review process before being reported. All data forms must be dated, signed and completely filled out in ink by the preparer. Notes will be made if information requested is non-applicable for the specific analysis. Each data sheet will be checked, signed, dated approved by someone other than the preparer.

Out-of-control events or potential out-of-control events are noted on an Out-of-Control Events form. This form is part of the Data Package and will be completed upon data approval. If no out-of-control event does occur during analysis (for instance, a spike recovery falls outside the expected range), the analyst will describe the event, the investigative and corrective action taken and the cause of the event on this form, and will notify the Quality Control Coordinator (QCC).

After an analyst completes a Data Package, it is given to the Supervisor for review. The Supervisor reviews the entire Data Package for completeness, discrepancies and errors and writes comments, when necessary, on the back of the Data Approval Form. If the Supervisor disapproves the Data Package, it is given back to the analyst for correction. If it is approved, the Supervisor passes it along to the QCC.

The QCC then reviews the Data Package with extra emphasis on the acceptability of quality control data. If the QCC disapproves the Data Package, it is re-routed to the Supervisor for corrective action. If the QCC approves it, it is sent to the Laboratory Manager, Supervisors and Quality Control Coordinator for their approval and signatures

10.2 Calculations

Concentration of Benzene Extractables = gain in weight of flask weight of sample

Concentration of Phenolics = concentration from standard curve x dilution factor

Dilution Factor = $\frac{500}{\text{g of sample}}$

10.3 Turnaround

In accordance with Section 11.1.3 of the CD-RAP the City will report the results of the borings and laboratory analyses within 60 days of completion of the borings.

Page: 33.A of 46 Date: June, 1988 Number: QAII.I Revision: 1

10.4 Analytical Results Report

Each analytical results report will contain the following:

- a. Field identification designation.
- b. Interpoll laboratory sample number.
- c. Analytical results (mg/kg)in terms of phenolics.

In addition, the City will make the Data Package, described in Section 7.2., available to the Agencies if so notified.

The analytical results report will be validated and signed by the Laboratory Manager.

Page: 34 of 46

Date: October, 1987

Number: QA11.1 Revision: 0

11. INTERNAL QUALITY CONTROL CHECK

11.1 Benzene Extractable and Phenolics

11.1.1 Method Blank and Solvent Blank

The laboratory will analyze 10% laboratory solvent blanks and 5% method blanks (Solvents taken through the entire analytical process).

The method blank results associated with the sample batch will be used to correct the observed sample concentrations.

The solvent blank is not used to correct sample concentrations but to help determine the cause of conatamination in high blanks.

11.1.2 Duplicates

The laboratory will analyze 5% duplicate samples. Percent difference between duplicates will be calculated for each parameter. The results will be plotted onto control charts and mean and standard deviation will be calculated.

Page: 35 of 46

Date: October, 1987

Number: QA11.1 Revision: 0

12. PERFORMANCE AND SYSTEM AUDITS.

Interpoll Laboratories participates in a variety of inter-laboratory testing and performance checks to provide periodic assessment of the effectiveness of the overall quality control programs.

12.1 Inter-Laboratory Performance Surveys

Performance surveys conducted by the EPA and Twin Cities Round Robin constitute the bulk on inter-laboratory comparisons.

a. EPA Performance Evaluations - Water Pollution - Semi-Annual (April and October)

Trace metals
Minerals
Nutrients
Ortho phosphate
Demands
Organics (includes phenol)
Total cyanide
Oil and grease

b. Twin Cities Round Robin - Bi-monthly - One of the Following Categories (Rotates):

Trace metals
Minerals
Nutrients
Demands
Specials (oil & grease, total cyanide, phenol, etc).

Interpoll's performance is evaluated by the respective agency after each round of testing and reported to Interpoll's Laboratory Quality Control Coordinator. The Laboratory Quality Control Coordinator summarizes the results in a report to the Division Quality Control Manager who reports to upper management.

12.2 Periodic In-House Audits

In-house auditing is conducted by the QA Manager with the assistance of the Laboratory OC Coordinator. These audits occur at least every six months and typically focus on a specific project. In-house audits take two forms - performance audits and systems audits. Performance audits involve submittal of blind spikes to the laboratory by the Quality Assurance Department for assessment of analytical accuracy. Systems audits consist of a thorough review of project procedures and documentation to confirm that work was performed in accordance with the Quality Assurance Project Plan and that adequate documentation exists to satisfy the project requirements.

Page: 36 of 46

Date: October, 1987

Number: QAII.1 Revision: 0

12.2.1 Performance Audits

Audit Standards

As required on specific projects, the Quality Assurance Department provides spikes for analysis as independent check samples (audit standards). The QA Department prepares any audit standards that can be prepared readily from relatively non-hazardous, neat materials or certified concentrated standards. In some cases, preparation of reliable audit standards requires special facilities and equipment due to the hazardous nature of the materials and/or the requirement for precise measurement of minute quantities. In such cases, audit standards are obtained from the USEPA, Environmental Monitoring and Support Laboratory (EMSL), Cincinnati, Ohio, or from an equivalent source. The nature of the audit standards and the frequency of performance audits are specified in the Quality Assurance Plan of each project for which performance auditing is required. When practical, audit standards are provided in matrices resembling real project sample matrices and undergo the full sample preparation and analysis procedure. However, in many cases, this is impractical, and it is necessary to submit audit as extracts, for analysis only. All measurable constituents in the audit standards should be within the expected range of concentrations to be encountered in the real samples (or in the extracts). They must be within the linear calibration range or the analytical equipment to be used.

Documentation

Performance audit standards are submitted to the Laboratory Ouality Control Coordinator by the Quality Assurance Manager or the Project Quality Assurance Officer in the appropriate, labeled containers. The label on each audit standard contains the following information as applicable:

Interpoll-Prepared Standards

- a. Date prepared
- b. Initials of preparer
- c. Project number
- d. Audit ståndard number.
- e. Analysis to be performed

EPA-Supplied Standards

- a. EPA EMSL identification number.
- b. Project number
- c. Audit standard number.
- d. Analytical method to be employed.

Page: 37 of 46

Date: October, 1987

Number: QA11.1 Revision: 0

All audit standards submitted to the laboratory are logged in the Ouality Assurance Department in a bound logbook. The following information is entered for each standard.

- a. Project number.
- b. Interpoll audit standard number.
- c. EPA EMSL identification number (if applicable).
- d. Date prepared or received.
- e. Description of matrix.
- f. Name and quantity of each measurable constituent.
- g. Identification and expiration date of each primary standard used.
- h. Identification of any analytical equipment used (e.g., analytical balance).
- i. Date submitted to laboratory.
- j. Analytical method to be employed.

Interpretation of Performance Audit Results

The audit standards are analyzed by the same procedures as the real samples. Analytical results are included in the analytical data package.

The Project Quality Assurance Officer obtains the analytical results from the Laboratory Quality Control Coordinator and compares them to the true concentrations entered for each audit standard in the Quality Assurance Logbook. For each measurable constituent of each audit standard, the percent recovery is determined. These results are interpreted as the accuracy of analyses represented by the performance audit.

12.2.2. Systems Audits

There are two different types of laboratory systems audits - Operations Audits and Project Audits. Systems audits of laboratory operations (Operations Audits are performed at a minimum frequency of once every six months. Operations audits address general laboratory operations and conformance to the applicable methodologies.

Project audits are performed to confirm that laboratory operations are meeting specified project objectives, but only if a question is raised as to the laboratory's ability to meet the objectives.

Page: 38 of 46

Date: October, 1987

Number: QA11.1 Revision: 0

Systems Audit Procedures

The systems audits are performed by the Quality Assurance Manager or his qualified designee. The Laboratory Quality Control Coordinator participates in the audits as the laboratory's representative. It is the QC Coordinator's responsibility to provide the auditor with access to relevant data files, facilities and records, and to assist the auditor in obtaining an objective assessment.

Audit checklists are used to ensure that all salient points are addressed and documented. The checklists are filled out legibly and reproducibly, in ink, by the auditor, and are signed and dated by the auditor when completed. The operations audit checklist is based on EPA laboratory evaluation criteria.

Audit checklist will cover at least the following areas:

a. Operations Audit

- Personnel qualifications and training records.
- Adequacy of laboratory facilities, including work space, lighting, ventilation and supplies.
- Organization of lab facilities, including cleanliness, chemical storage and waste disposal.
- Maintenance and calibration recordkeeping for analytical equipment.
- Safety (facility configuration and practices.
- General operations, including glassware cleaning, inventory and checking of reagents and standards, and storage procedures.
- Recordkeeping, including sample log-in and tracking. traceability of standards, control charts, data packages, and organization of filing systems.

b. Project Audit

- Sample log-in and chain-of-custody records.
- Sample storage procedures and records.
- Sample preparation and analysis procedures.
- Method validation (where applicable).
- Control charts
- Precision and accuracy assessment.
- Method blanks, reagent blanks, duplicates, check samples, fortifications, surrogates, etc.

Page: 39 of 46 Date: October, 1987 Number: QAll.1 Revision: 0

- Calibration.

- Data packages.
- Analysts qualifications.
- Data validation and reporting.

Page: 40 of 46 Date: June, 1988 Number: QAll.1 Revision: 1

13. PREVENTIVE MAINTENANCE

Since instrumental methods of analysis require properly maintained and calibrated equipment, the operation and maintenance of modern analytical instrumentation is of primary importance in the production of acceptable data. In order to provide this data, STS and Interpoll subscribe to the following programs.

- a. Maintenance agreements/service contracts with instrument manufacturers.
- b. Laboratory preventive maintenance program.

13.1 Service Contracts

Analytical equipment utilized in Interpoll laboratory personnel for this project are covered by maintenance agreements. These maintenance agreements provide for both periodic "preventive" service calls as well as the non-routine or emergency calls.

13.2 Instrument Logbooks

Individual instrument logbooks are maintained for each piece of equipment and located near the instrument. General information contained in the logbooks include:

- a. Inventory information: Equipment name, model number, serial number, manufacturer, date of acquisition, original cost.
- b. Service tasks and intervals: Cleaning, calibration, operation based on the manufacturer's recommended schedule, and previous laboratory experience.
- c. Service record: Date of breakdown, date of return to service, down time, problems, repairs, cost of repairs, who performed the repairs, parts required, etc.
- d. Calibration/performance checks.
- e. Daily operational notes.

Analysts are referred to manufacturer's operating manuals for specific procedures to be followed in the operation and/or maintenance of the individual instrument.

Laboratory preventive maintenance includes any tasks that can be performed in-house, i.e., systematic cleaning of component parts as recommended in the instrument manual. If problems cannot be corrected by laboratory personnel, the instrument service representative is contacted and a service call requested to correct the problem.

Page: 40A of 46 Date: June, 1988 Number: QAll.1 Revision: 1

13.3 Field Measurement Equipment

The HNU photoionization detector used by STS in the field analysis of soil samples shall be maintained in accordance with the requirements of the manufacturer and as outlined in SOP STS-02, Appendix A to this Quality Assurance Project Plan.

Page: 41 of 46

Date: October, 1987

Number: QA11.1 Revision: 0

14. SPECIFIC PROCEDURES TO ASSES DATA PRECISION, ACCURACY AND COMPLETENESS

A quality control program is a systematic process that controls the validity of analytical results by measuring the accuracy and precision of each method and matrix, developing expected control limits, using these limits to detect errors or out-of-control events, and requiring corrective action techniques to prevent or minimize the recurrence of these events.

14.1 External and Internal Components

The accuracy and precision of sample measurements are influenced by both external and internal factors. External factors or errors are those associated with field collection and sample transportation. Internal factors or errors are those associated with sample preparation and analysis.

14.1.1 External Components: Accuracy and Precision Measurements

The results for quality control samples taken in the field represent the best estimates of accuracy and precision for the samples, since these values reflect the entire process from sample collection through sample analysis. Below is a brief description of the information provided by each of these control samples:

- .a. Field matrix spike provides an estimate of bias based on recovery; includes matrix effects associated with sample preservation, shipping, preparation and analysis.
- b. Field collected samples or duplicates independent samples collected at the same point in space and time. These give the best measurement of precision for sample collection through analysis.
- c. Field duplicate a sample that has been divided into two or more portions. The analytical values obtained for each of these portions gives a second best measurement of precision for the entire sampling and analysis scheme.

14.1.2 Internal Components: Accuracy and Precision Measurements

The results of quality control samples created in the laboratory represent estimates of analysis and precision for the preparation and analysis steps of sample handling. This section describes the quality control-type information provided by each of these analytical measurements. The frequency of each of these measurements is discussed in Section 11.0, Internal Quality Control Checks.

Accuracy Measurement

a. Laboratory fortifications - provide an estimate of bias based on recovery of the compounds analyzed for the sample batch, incorporating matrix effects associated with sample preparation and analysis.

Page: 42 of 46

Date: October, 1987

Number: QA11.1 Revision: 0

b. Surrogates - provide an estimate of bias based on recovery of similarly compounds, but not the compounds analyzed, for each sample, incorporating matrix effects associated with sample preparation and analysis.

- c. Internal standard an analyte that has the same characteristics as the surrogate but is added to each sample in a batch, just prior to analysis. It measures bias or change in instrument performance from sample to sample, incorporating matrix effects associated with the analysis process only.
- d. Analysis matrix spikes The analysis spike is added prior to analysis. These spikes are similar to the internal standard, however, the analyte used is the same as that being analyzed and usually is added to a selected few samples in a batch of analyses. It incorporates matrix effects associated with the analysis step only.

Precision Measurement

- a. Laboratory duplicates a sample that has been homogenized and split into two equal portions before the method sample preparation process. It measures sample precision associated with the preparation through analysis.
- b. Analysis replicate a sample solution or extract that has been split before analysis: measures sample precision associated with the analysis only.

14.2 Control Charts

Control charts are quality control tools which graphically display the progression or movement of similar points taken at regular intervals in a process or over time. Both accuracy and precision control charts are maintained for each method and matrix.

14.2.1 Accuracy

Accuracy charts are maintained for surrogate and laboratory fortification recoveries. Each sample is identified by the date it was prepared and analyzed and its Interpoll sample number. Values are plotted as percent recovered on an x-y graph. The mean, warning and control limits are presented graphically to enable a concise review of accuracy of the analysis.

14.2.2 Precision

Precision charts are maintained for laboratory duplicates. Both samples are identified by the date (s) prepared and analyzed and their Interpoll number. Values are plotted as percent differences on an x-y graph. The mean, warning and control limits are presented graphically to enable review of the preecision of the analysis.

Page: 43 of 46 Date: June, 1988 Number: QAll.1 Revision: 1

14.2.3 Limits

Both upper and lower warning limits and upper and lower control limits are established to aid in interpreting a suspicious or an out-of-control event. Warning limits express a narrower confidence interval and are used to warn the analyst or supervisor of possible system inconsistencies or failures, before an out-of-control event occurs. Control limits express the out limits of excepted method variability.

14.3 Suspicious/Out-of-Control Events

Graphing and connected successive data points on control charts enables the laboratory to detect many types of suspicious and out-of-control situation. These events can be caught by monitoring for the following: Outliers (suspicious and out-of-control), runs (suspicious), trends (suspicious) and periodicity (suspicious).

14.3.1 Outliers

There are two types of outliers: Any particular point that falls outside the control limits or any point that falls outside the warning limits. A point that falls outside the control limits is classified as an out-of-control event; a point that falls outside the warning limits is classified as a suspicious event.

14.3.2 Runs

A run is defined as a series of points that line up on one side of the central line (the mean). Any run that has a length of seven points is indicative of a potential abnormality in the process, a suspicious event. A run can suggest several potential problems such as elevated contamination or incorrect dilutions of standards.

14.3.3 Trends

A Trend is defined as a series of points that are marked by an unbroken rise or fall. Any trend with a length of five points is classified as a suspicious event. A trend may indicate a change in instrument sensitivity due to a dirty source or injection port or standard degradation, to name a few.

14.3.4 Periodicity

Periodicity is a term used to describe a recurring pattern of change over equal intervals. This occurrence may be of any length or amplitude; thus, careful observation of the control chart is necessary.

14.4 Acceptance Criteria

14.4.1 Accuracy

The required analyte recovery for both phenolic and benzene extracted spiked samples shall be a minimum of 50% and a maximum of 180%.

Page: 43.A of 46 Date: June, 1988 Number: QAll.1 Revision: 0

14.4.2 Precision

The required reproducibility of split sample analysis for both phenolic and benzene extractables shall be a relative percent difference no greater than 50%.

14.4.3 Sensitivity

Required detection limit for benzene extractables shall be 500~mg/kg, and 1~mg/kg for phenolics.

14.4.4 Completeness

90% of analytical data shall meet the above criteria for accuracy, precision and sensitivity.

Page: 44 of 46.
Date: June, 1988
Number: QAll.1
Revision: 1

15. CORRECTIVE ACTION

Corrective actions are required whenever an out-of-control event or potential out-of-control event is noted. The investigative action taken is somewhat dependent on the analysis and the event.

Generally, out-of-control events or potential out-of-control events are noted on an Out-of-control Events Form (Figure 15-1). This form is part of the data package and, thus, must be completed prior to data approval. If an out-of-control event does occur during analysis (for instance, a surrogate recovery falls outside the expected range), the analyst must describe on this form: The event, and notify the Laboratory Quality Control Coordinator (QCC). In some cases, investigation of an out-of-control event will reveal no problems. If an out-of-control event is discovered during data package review, the QCC notifies the supervisor for corrective action.

15.1.1 Matrix Spikes

Interpoll will use phenol spiked into a sample of soil collected in the field. The spiking levels will be two or three times the amount observed in the sample.

If the matrix spike criteria are not met, the matrix spike analysis will be repeated. If the subsequent matrix spike analysis meets the criteria, the data will be considered valid. Matrix spike recoveries will be used in assessing quality assurance/quality control for Interpoll's analytical work.

15.1.2 Duplicate Analysis

Interpoll will run duplicate analysis on 5% of submitted samples for both phenolics and benzene extractables.

15.2 Project Specific Out of Control Criteria

15.2.1 Accuracy

The required analyste recovery for both phenolic and benzene extracted spiked samples shall be a minimum of 50% and a maximum of 180%.

15.2.2 Precision

The required reproducibility on split sample analysis for both phenolics and benzene extractables shall be a relative percent difference no greater than 50%.

15.3 Accuracy and Precision Review

Accuracy and Precision data will be reviewed by the Quality Control Coordinator. If an out of control situation exists, this will be brought to the attention of the analyist and the Inorganic Chemistry Department Manager. After problem resolution, sign-offs are required by the Analyist, the QCC, the Department Manager, the Division Quality Control Manager and the Laboratory Director.

Interpoll Laboratories

Page: 45 of 46 Date: June, 1988 Number: QA11.1

Number: QAII Revision: l

Out of Control Events Log

Analyte	Method		
Date		Measurement	
Nature of Out of Control Situa	ation:		
			•
		·	
Discussion:			
	•		
		· - · · · · · · · · · · · ·	
Action Taken:	·-···-		
		<u> </u>	
Analyst	Reviewed by		000
Dept. Mgr			DAM .
			Lab Director

Page: 46 of 46

Date: October, 1987

Number: QA11.1 Revision: 0

16. QUALITY ASSURANCE REPORTS TO MANAGEMENT

The Interpoll Quality Assurance Department is completely indepedent of line function. Its manager reports exlusively to the Interpoll Chemistry Division Director. The Laboratory Quality Control Manager who reports directly to the Division Director.

Reports summarizing any changes in quality control procedures and guidelines, updated control limits and any deviations are made on a periodic basis to both laboratory and corporate management. These occur through a regular quarterly report from the Laboratory QC Coordinator to the Division QC Manager. Copies of this report are also submitted to the Division Director, the Laboratory Managers and Supervisors. Should the circumstances warrant more frequent communication between the laboratory QCC, the QC Manager or any other persons in management, both verbal and written communication will be implemented.

16.1 Performance and System Audits

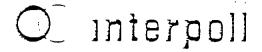
Final performance and system audit reports are issued to project management and to corporate management. Items requiring corrective action are documented on a Correction Action Request Form addressed to the project manager. The Corrective Action Request is a three-part NCR-type form. The first copy is retained by the Quality Assurance Department upon issuance. The project manager receives the original and one copy. When satisfactor progress has been achieved on each requested action, the project manager or designee enters descriptions of actions and results on the form, then retains the copy and returns the original to the Quality Assurance Department to close the loop.

Results of inter-laboratory performance surveys and in-house audits, along with unresolved corrective action items, are summarized in a quarterly report from the Quality Assurance Manager to the President.

APPENDIX D

ANALYTICAL RESULTS

This Appendix contains 8 pages.



INTERPOLL LABORATORIES, INC. 4500 BALL RCAD N.E. CIRCLE PINES, MINNESOTA 55014-1819 TEL. 612/786-6020 FAX: 612/786-7854

STS Consultants 3650 Annapolis Lane Minneapolis, MN 55441

Attention: Jim Overtoom

LAECRATORY REPORT: #6711 STS PROJECT: #94019A

September 28, 1988

SAMPLES COLLECTED: Sectember 12, 1988

SAMPLES RECEIVED: September 14, 1988

Sample Identification: E6bS #4 B9E #8 B7S #6 Sample Type: Soil Sail Spil Laboratory Log Number: 6711-04 6711-14 6711-32 Parameter Lnits Methca Phenol mg/kg SW-846, 9065 < 0.2 0.2 < 0.2 Benzene extractable hydrocarbons % w/w SW-846, 9071 0.094 0.011 0.013 Moisture by toluene distillation % ASTM D95 28.91 13.39 15.51

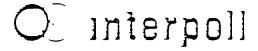
Rescectfully submitted,

Dung M. Afel

Gregg W. Holman,

Inorganic Chemistry Department Manager

GwH/cg Invoice Enclosed < = less than



INTERPOLL LABORATORIES, INC. 4500 SALL ROAD N.E. CIRCLE PINES, MINNESOTA 55014-1819 TEL: 612/786-6020 FAX: 612/786-7854

STS Consultants CáSO Annacolis Lane Minneacolis, MN 55441

Attention: Jim Gvertoom

LABORATORY REPORT: #6696

STS PROJECT: #94019A

September 28, 1988

SAMFLES COLLECTED: September 12, 1988 SAMFLES RECEIVED: September 12, 1988

Sample Identification: Sample Type: Laboratory Log Number:			645 #2 Soil <u>6676-72</u>	B4S #3 Scil <u>6696</u> —03	845 #4 Soil <u>6696—)4</u>	B5S #7 Sail <u>6696−15</u>
Parameter	<u>Units</u>	Method				
Phenol Benzene extractable	mg∕kg	SW-346, 9065	< 0.2	< 0.2	< 0.2	< 0.2
hydrocarbons Moisture by toluene	% w/w	SW-346, 9071	1.4	0.60	0.022	0.015
distillation	%	ASTM D95	81.77	71.01	38.94	15.62

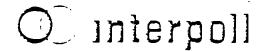
Respectfully submitted,

Gregg W. Holman,

Livy M Had

Inorganic Chemistry Department Manager

GwH/cg Invoice Enclosed < = less than



INTERPOLL LABORATÓRIES, INC. 4500 BALL ROAD N.E. CIRCLE PINES, MINNESOTA 55014-1819 TEL: 612/786-6020 FAX: 612/786-7854

STS Consultants 3650 Annapolis Lane Minneacolis, MN 55441

Attention: Jim Overtoom

LABORATORY REPORT: #6691

#CC21

STS FROJECT: #94019A

SAMPLES COLLECTED: September 7, 1988 SAMPLES RECEIVED: September 9, 1988

Sample Identification:

a:

Sample Type: Water Laboratory Log Number: 6691-01

<u>Parameter</u> <u>Units</u> <u>Method</u>

Phenol mg/L EFA 420.2 < 0.006
Benzene extractable hydrocarbons % w/w SW-346, 9071 0.0022

Sample Identification: B2 S#5 B3 S#5 Sample Type: Soil Soil Laboratory Log Number: 6691-17

<u>Parameter</u> Units Method 0.22 Phenal/ mg/kg E=A 420.2 0.26 0.23 SW-846, 9071 0.017 Benzene extractable hydrocarbons % w/w 15.18 37.75 ASTM D95 Moisture by toluene distillation %

Respectfully submitted,

Green M. All

Gregg W. Holman,

October 11, 1988

Inorganic Chemistry Department Manager

BZEF

GwH/cg Invoice Enclosed < = less than

O_interpoll

INTERPOLL LABORATORIES, INC. 4500 BALL ROAD N.E. CIRCLE PINES, MINNESOTA 55014-1819 TEL: 612/786-6020 FAX: 612/786-7854

STS Consultants 3650 Annapolis Lane Minneapolis, MN 55441

Attention: Jim Overtoom

LABORATORY REPORT: #6672

STS PROJECT:

#94019A

SAMPLES RECEIVED:

SAMPLES COLLECTED: September 6, 1988 September 7, 1988

Units

mg/kg

<u>Units</u>

Sample Identification:

Sample Type:

Laboratory Log Number:

Parameter

Pheno1 Benzene extractable hydrocarbons % w/w

Moisture by toluene distillation %

Sample Identification:

Sample Type: Laboratory Log Number:

<u>Parameter</u>

mg/L Phenol % w/w Benzene extractable hydrocarbons

October 11, 1968

B-1

B-1S#6

Scil

B-1 S#3 5#5 Soil Soil <u>6672-02</u> <u>6672−03</u> 6672-01

0.2 0.2

0.2 0.005 0.042 0.008 37.55 13.13 13.52

DE

Liquid 6672-04

Method

Method

EPA 420.2

ASTM D95

SW-246, 9071

EPA 420.2 SW-546, 9071

0.006 0.0014

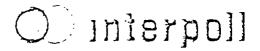
Respectfully submitted,

Bring Mr Hol Gregg W. Holman,

Inorganic Chemistry Department Manager

GWH/cq

Invoice Enclosed < = less than</pre>



INTERPOLL LABORATORIES, INC. 4500 BALL ROAD N.E. CIRCLE PINES, MINNESOTA 55014-1819 TEL: 612 786-6020 FAX: 512:786-7854

STS Consultants 3650 Annacolis Lane Minneapolis, MN 55441

Attention: Jim Overtoom

LAECRATCRY FEFCRT: #6782

Cctcter 17, 1988

STS FROJECT:

#94019A

(City of St. Louis Park)

SAMPLES COLLECTED: September 23, 1988 SAMPLES RECEIVED: September 23, 1988

Sample Identification: Sample Type: Laboratory Log Number:			B14 S#5 Søil <u>6782-</u> 05	B14 S#11 Soil <u>6782-11</u>	815 S#4 Scil <u>6782-15</u>	815 S#6 Soil 6782-17
<u>Farameter</u>	<u>Lhits</u>	<u>Method</u>				
Phenol Benzene extractable	mg/kg	SW-846, 9065	0.24	< 0.2	< 0.2	< 0.2
hydrocarbons Moisture by toluene	% w/w	SW-946, 9071	< 0.005	0.020	< 0.005	< 0.005
distillation	%	ASTM D95	15.0	16.3	14.9	13.2

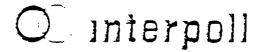
Respectfully submitted,

Kung W. All

Gregg W. Holman,

Inorganic Chemistry Department Manager

GWH/cg Invoice Enclosed < = less than</pre>



INTERPOLL LABORATORIES, INC. 4500 BALL ROAD N.E. CIRCLE PINES, MINNESOTA 55014-1819 TEL: 512/786-6020 FAX: 612:786-7854

OCT 19. 82

STS Consultants 3650 Annacolis Lane Minneacolis. MN 55441

Attention: James Overtoom

LABORATORY REPORT: #6772A

October 17, 1988

STS PROJECT:

#94019A

(City of St. Louis Park)

SAMPLES COLLECTED: September 22, 1988 SAMPLES RECEIVED: September 23, 1988

Sample Identification: Sample Type: Laboratory Log Number:			B-12 S#3 Soil <u>6772-03</u>	B-13 S#2 Soil 6772-10
Parameter	<u>Units</u>	Method		
Phenol Benzene extractable	mg/kg	SW-846, 9065	< 0.2	0.50
hydrocarbons	% w/w	SW -8 46, 9071	< 0.005	0.18
Moisture by toluene distillation	%	ASTM D95	16.0	ಟ.2

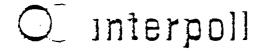
Respectfully submitted,

Dung M. Hel

Greeg W. Helman,

Inorganic Chemistry Department Manager

GWH/cg Invoice Enclosed < = less than</pre>



INTERPOLL LABORATORIES, INC. 4500 BALL ROAD N.E. CIRCLE PINES, MINNESOTA 55014-1819 TEL: 612/786-6020 FAX: 612/786-7854

STS Consultants 3650 Annapolis Lane Minneapolis. MN 55441

Attention: Jim Overtoom

LABORATORY REPORT: #6711A

STS PROJECT: #74019A

711A Catober 17, 1988

SAMPLES COLLECTED: September 12, 1988 SAMPLES RECEIVED: September 14, 1988 ANALYSIS RECLESTED: September 23, 1988

Sample Identification Sample Type: Laboratory Log Number		B-á S#6 Soil <u>6711-06</u>	B-3 S#6 Soil <u>6711-22</u>	B-7 S#2 Scil <u>6711-26</u>	
Parameter	<u>Units</u>	Method			
Phenol Benzene extractable	mg/kg	SW-846, 9065	< 0.2	< 0.2	< 0.2
hydrocarbons Moisture by toluene	% w/w	SW-846, 9071	0.008	< 0.005	< 0.005
distillation	7.	ASTM D95	9.60	14.4	28.5

Respectfully submitted,

Lung M. Nick

Gregg W. Holman,

Inorganic Chemistry Department Manager

GWH/cg
Invoice Enclosed
< = less than

APPENDIX E

PART O CORRESPONDENCE

This Appendix contains 7 pages.



CERTIFIED MAIL RETURN RECEIPT REQUESTED

November 17, 1988

Regional Administrator
United States Environmental Protection
Agency, Region 5
ATTN: Hazardous Waste Enforcement
Branch
230 South Dearborn Street
Chicago, Illinois 60604

President
Reilly Tar & Chemical Corporation
1510 Market Square Center
151 North Delaware
Indianapolis, Indiana 46204

Director, Solid and Hazardous Waste Division Minnesota Pollution Control Agency ATTN: Site Response Section 520 Lafayette Road North St. Paul, Minnesota 55155

RE: United States of America, et al. vs. Reilly Tar & Chemical Corporation, et al. File No. Civ. 4-80-469

Gentlemen:

In accordance with the provisions of Part O of the Consent Decree in the referenced case, this letter shall confirm that the City of St. Louis Park will forego the installation of ten optional soil borings at this time pursuant to Section 11.1. of the Remedial Action Plan (RAP) in the referenced case. This decision was reached based upon a preliminary review of data developed during the analysis of samples retrieved from 15 required soil borings and was communicated to the City by Minnesota Pollution Control Agency Alternate Project Leader Justin Blum. Based upon the confirming conversation with Mr. Blum, the City has commenced the development of the project report pursuant to the requirements of RAP Section 11.1.3. Said report shall be completed within 60 days of November 14, 1988, the day Mr. Blum and this office reached agreement relative to the final disposition of the boring/analysis/reporting issue.

Sincerely,

James N. Grube
Director of Public Works

JNG/ja

P.E. Sar Jerigo Dr. installations of 10 options of said said soungs pursuant to Sec 11.1. of RAP. in accordance with text O of a.i.

mailer: Mar. 17, 1988.

card from being returned to you. The return receipt fee wind delivered to and the date of delivery. For additional fees the postmaster for fees and check box(es) for additional services.	e(s) requested.
 Show to whom delivered, date, and addressee's addressee's 	ess. 2. Restricted Delivery.
3. Article Addressed to:	4. Article Number P 125 579 561
Dir, Solid & Haz Waste Div	Type of Service:
MN Pollution Control Agency ATTN: Site Response Section	☐ Registered ☐ Insured ☐ COD ☐ Express Mail
520 Lafayette Road North St. Paul, MN 55155	Always obtain signature of addressee or agent and DATE DELIVERED.
5. Signature - Addressee, - X.G. Ml. Washington	8. Addressee's Address (ONLY if requested and fee paid)
6. Signature — Agent	
x /	
7. Date of Delivery	5 · 4 · 5 · 4 · 6
S Form 3811, Feb. 1986	
SENDER: Complete items 1 and 2 when additional Put your address in the "RETURN TO" space on the recard from being returned to you. The return receipt feed delivered to end the date of delivery. For additional seed postmaster for fees and check box(es) for additional seed. 1. Show to whom delivered, date, and addressee's a 3. Article Addressed to:	everse side. Failure to do this will prevent the will provide you the name of the person as the following services are evailable. Consulvice(s) requested.
SENDER: Complete items 1 and 2 when additional Put your address in the "RETURN TO" space on the recard from being returned to you. The return receipt fee delivered to and the date of delivery. For additional fee postmaster for fees and check box(es) for additional set 1. Show to whom delivered, date, and addressee's a 3. Article Addressed to:	services are desired, and complete items 3 a everse side. Failure to do this will prevent the will provide you the name of the person as the following services are evailable. Consurvice(s) requested. 2. Restricted Delivery.
SENDER: Complete items 1 and 2 when additional Put your address in the "RETURN TO" space on the recard from being returned to you. The return receipt feed delivered to and the date of delivery. For additional feed postmaster for fees and check box(es) for additional set 1. Show to whom delivered, date, and addressee's at 3. Article Addressed to: President Reilly Tar & Chemical Corp 1510 Market Square Center 151 North Delaware Street	services are desired, and complete items 3 a everse side. Failure to do this will prevent the will provide you the name of the person est the following services are available. Consurvice(s) requested. 2. Restricted Delivery. 4. Article Number
SENDER: Complete items 1 and 2 when additional Put your address in the "RETURN TO" space on the recard from being returned to you. The return receipt feed delivered to and the date of delivery. For additional feed postmaster for fees and check box(es) for additional set 1. Show to whom delivered, date, and addressee's at 3. Article Addressed to: President Reilly Tar & Chemical Corp 1510 Market Square Center 151 North Delaware Street Indianapolis, Indiana 46204	services are desired, and complete items 3 a severse side. Failure to do this will prevent the will provide you the name of the person is the following services are available. Consurvice(s) requested. Iddress. 2. Restricted Delivery. 4. Article Number 7.3.5.5.7.9.5.6.0 Type of Service: Registered Insured Contified Contif
SENDER: Complete items 1 and 2 when additional Put your address in the "RETURN TO" space on the recard from being returned to you. The return receipt feed delivered to and the date of delivery. For additional feed postmaster for fees and check box(es) for additional set 1. Show to whom delivered, date, and addressee's at 3. Article Addressed to: President Reilly Tar & Chemical Corp 1510 Market Square Center 151 North Delaware Street	services are desired, and complete items 3 a severse side. Failure to do this will prevent the will provide you the name of the person as the following services are available. Consurvice(s) requested. Iddress. 2. Restricted Delivery. 4. Article Number 725579560 Type of Service: Registered Insured Consur
SENDER: Complete items 1 and 2 when additional Put your address in the "RETURN TO" space on the recard from being returned to you. The return receipt fee delivered to end the date of delivery. For additional see postmaster for fees and check box(es) for additional see 1. Show to whom delivered, date, and addressee's a 3. Article Addressed to: President Reilly Tar & Chemical Corp 1510 Market Square Center 151 North Delaware Street Indianapolis, Indiana 46204 5. Signature Addressee X	services are desired, and complete items 3 a geverse side. Failure to do this will prevent the will provide you the name of the person is the following services are available. Consurvice(s) requested. Iddress. 2. Restricted Delivery. 4. Article Number 725579560 Type of Service: Registered Insured Consumption Consured Con
SENDER: Complete items 1 and 2 when additional Put your address in the "RETURN TO" space on the recard from being returned to you. The return receipt feet delivered to end the date of delivery. For additional seed postmaster for fees and check box(es) for additional seed 1. Show to whom delivered, date, and addressee's a 3. Article Addressed to: President Reilly Tar & Chemical Corp 1510 Market Square Center 151 North Delaware Street Indianapolis, Indiana 46204 5. Signature Addressee X Addressee X 6. Signature Addressee X 7. Date of Delivery	services are desired, and complete items 3 a geverse side. Failure to do this will prevent the will provide you the name of the person is the following services are available. Consurvice(s) requested. Iddress. 2. Restricted Delivery. 4. Article Number 725579560 Type of Service: Registered Insured Consumption Consured Con
SENDER: Complete items 1 and 2 when additional Put your address in the "RETURN TO" space on the recard from being returned to you. The return receipt fee delivered to and the date of delivery. For additional see postmaster for fees and cneck box(es) for additional see 1. Show to whom delivered, date, and addressee's a 3. Article Addressed to: President Reilly Tar & Chemical Corp 1510 Market Square Center 151 North Delaware Street Indianapolis, Indiana 46204 5. Signature Addressee X 6. Signature Addressee X 6. Signature Agent	services are desired, and complete items 3 a geverse side. Failure to do this will prevent the will provide you the name of the person is the following services are available. Consurvice(s) requested. Iddress. 2. Restricted Delivery. 4. Article Number 725579560 Type of Service: Registered Insured Consumption Consured Con

SENDER: Complete items 1 and 2 when additional service Put your address in the "RETURN TO" space on the reverse card from being returned to you. The return receipt fee will delivered to and the date of delivery. For additional fees the	side. Failure to do this will prevent this provide you the name of the person following services are available. Consult
postmaster for fees and check box(es) for additional service(s	
1. U Show to whom delivered, date, and addressee's addres	
3. Article Addressed to:	4. Article Number P 725 579 559
Regional Administrator	Type of Service:
USEPA, Region 5 ATTN: Haz Waste Enforcem't Br 230 South Dearborn Street	Registered Insured COD Express Mail
Chicago, Illinois 60604	Always obtain signature of addressee or agent and DATE DELIVERED.
5. Signature — Addressee X	8. Addressee's Address (ONLY if requested and fee paid)
6. Signature – Agent X 7. Date of Delivery	
1//1//88	<u>:</u>
PS Form 3811, Feb. 1986	DOMESTIC RETURN RECEIPT

Exect

事治さ



September 23, 1988

Ms. Erin Moran
Remedial Project Leader
United States Environmental
Protection Agency, Region 5
230 South Dearborn Street
Chicago, Illinois 60604

Mr. Michael K. Vennewitz Remedial Project Leader Minnesota Pollution Control Agency 520 Lafayette Road North St. Paul, Minnesota 55155

Mr. John Craun, President Reilly Tar & Chemical Corporation 1510 Market Square Center 151 North Delaware Indianapolis, Indiana 46204

RE: United States of America, et al. vs. Reilly Tar & Chemical Corporation, et al. File No. Civ. 4-80-469

Dear Project Leaders:

Pursuant to the requirements of the Quality Assurance Project Plan (QAPP) for the Soil Investigation work task (Section 11.1. of the Remedial Action Plan), I have enclosed corrected pages 3, 16, and 16A. While pages 16 and 16A reflect changes in the field decontamination procedures, page 3 reflects the correct format of the table of contents.

Please remove existing pages 3, 16, and 16A from the QAPP section and replace them with the enclosed pages.

Sincerely,

James N. Grube

Director of Public Works

James of Strube

JNG/ja Enclosure

cc: Dick Koppy Jim Overtoom Bill Gregg

Page: 3 of 46
Date: Sept., 1988
Number: QAll.1
Revision: 1

8.	CALIB	RATED PROCEDURES	24
	8.2	Analysis of phenolics Analysis of Benzene Extractables Field Measurement Equipment 8.3.1 HNU Photoionization Detector 8.3.2 Biosnesor II Combustible Gas indicator	24 24 24 24 24
9.	ANALY	TICAL PROCEDURES	25
	9.1	Analysis of Phenolics and Benzene Extractables	25
		9.1.1 Summary 9.1.2 Benzene Extractables - EPA Method 9071 I 9.1.3 Phenolics - EPA Method 9065 I	25 25 .29
10.	DATA	REDUCTION, VALIDATION AND REPORTING	33
	10.2 10.3	Data Reduction and Validation Calculations Turnaround Analytical Results Report	33 33 33 33
11.	INTER	RNAL QUALITY CONTROL CHECK	34
		1 Benzene Extractable and Phenolics 2 Duplicate	34 34
12.	PERF	DRMANCE AND SYSTEMS AUDITS	35
		Inter-Laboratory Performance Surveys Periodic In-House Audits	35 35
		12.2.1 Performance Audits 12.2.2 Systems Audits	36 37
13.	PREV	ENTATIVE MAINTENANCE	40
	13.2	Service Contracts Instrument Logbooks Field Measurement Equipment	40 40 40
14.	SPEC	IFIC PROCEDURES TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS	41
	14.1	External and Internal Components	41
		14.1.1 External Components: Accuracy and Precision Measurements 14.1.2 Internal Components: Accuracy and Precision Measurements	41 41
	14-2	Control Charts	42
		14.2.1 Accuracy 14.2.2 Precision 14.2.3 Limits	42 42 43

Page: 16 of 46
Date: Sept., 1988
Number: QA11.1
Revision: 2

4. Whenever samples are split with another laboratory, it is noted in the "Remarks" section. The note indicates with whom the samples are being split and is signed by both the sampler and recipient. If either party refuses a split sample, this will be noted and signed by both parties. The person relinquishing the samples to the facility or agency should request the signature of a representative of the appropriate party, acknowledging receipt of thee samples. If a representative is unavailable or refuses to sign, this is noted in the "Remarks" space. When appropriate, as in the case where the representative is unavailable, the custody record should contain a statement that the samples were delivered to the designated location at the designated time.

6.3.3 Field Forms

In addition to sample labels and chain-of-custody forms, a bound field notebook will be maintained by the sample team leader to provide a daily record or significant events. All entries will be signed and dated. All members of the sampling team will use this notebook. The notebook will be kept as a permanent record.

6.4. Sampling Procedures

For this study, background levels of benzene extractable hydrocarbons will be determined by testing a maximum of 10 samples classified by the sence of smell as "clean". The City's representative will be responsible for designating at lease one sample retrieved from each soil boring for laboratory analysis for benzene extractable hydrocarbons. Accordingly, at least 25 samples will be analyzed during the initial round of sampling. In the event up to 10 additional soil borings are undertaken in a follow-up round, at least one sample will be returned from each boring, up to a total of 20 samples, and all samples will be analyzed for benzene extractable hydrocarbons.

Soil samples, weighing, at least 200 grams will be obtained using the split-barrel sampling procedure in general conformance with ASTM Specification D-1586-84. The geologist will take possession of the split-barrel sampler immediately upon its emergence from the borehole, prepare all soil samples for laboratory analysis, and classify the samples in m.l. wide mouth clear glass sample containers fitted with aluminum foil lined caps. All samples shall be packed, cooled to a temperature less than 4 C and shipped to the analytical laboratory on the same day.

A new pair of disposable latex gloves will be used for each sampling site. Between sites, and between each use of the split-barrel sampler, sampling equipment will be steam cleaned or washed with soap (trisodium phosphate) and potable water.

Steam cleaning is required whenever separate phase hydrocarbons are encountered, and is the perferred cleaning method. Soap and water cleaning may be used in lieu of steam cleaning provided that the cleanest available equipment (e.g., split spoons) are used and that the method is effective in removing all dirt from the equipment. Following soap and water cleaning, the sampling equipment will be rinsed with methenol, hexane, methanol, air dried in a contaminant free area, then rinsed with potable water prior to reuse.

Page: 16.A of 46 Date: Sept., 1988 Number: QAll.1 Revision: 2

6.5. Field Measurement Equipment

All field measurement equipment will be controlled in accordance with manufacturer's specifications to ensure that measurements obtained are accurate and defensible. Specific field measurement equipment shall include an HNU Photoionization Detector.

6.6. Duplicate Samples

Duplicate samples will be collected by splitting the sample longitudinally with a stainless steel knife, and each half will be placed in separate sample jars.

APPENDIX F

DRILLER'S REPORT

This Appendix contains 27 pages.



STS Consultants Ltd.
Consulting Engineers

3650 Annapolis Lane Minneapolis, Minnesota 55447 (612) 559-1900

January 6, 1989

Mr. James N. Grube, P.E. Director of Public Works City of St. Louis Park 5005 West Minnetonka Boulevard St. Louis Park, MN 55416-2290

STS Project 94019-A

Re: Reilly Tar Site Soil Borings for Chemical Analysis

Dear Mr. Grube:

In accordance with the Consulting Service Contract No. 1866 between the City of St. Louis Park and STS Consultants. Ltd. amended July 18, 1988, fifteen exploratory soil borings were drilled to nominal depths of 36 to 55 feet below the existing ground surface. The locations of these borings was determined by the City of St. Louis Park, approved by appropriate regulatory agencies. This work was conducted in accordance with the provisions of the Consent to Decree in United States of America, ET AL, versus Reilly Tar & Chemical Corporation. Housing and Redevelopment Authority of St. Louis Park. Oak Park Village Associates. Rustic Oaks Condominium. Inc. and Phillips Investment Company. United States District Court. District of Minnesota, Civil File No. 4-80-469. Enclosed, is a description of the work performed, as well as the results of the soil borings and chemical analysis completed. Six copies of this report have been sent to the above address.

We have enjoyed having the opportunity to be of assistance to you on this project. If you have any questions about the contents of this report, please do not hesitate to contact us.

Very truly yours,

STS CONSULTANTS, LTD.

James H. Overtoom, P.E.

Principal Engineer

Donald C. Johnston

Environmental Geologist

JHO/dj Encs.

INTRODUCTION

STS Consultants. Ltd. has completed the subsurface exploration outlined in the Remedial Action Procedure. Soil Investigation Work Task (Section 11.1 of the Remedial Action Plan). This work was completed in accordance with Contract No. 1866 between the City of St. Louis Park and STS Consultants. Ltd. The Remedial Action Procedure. Soil Investigation Work Plan. comprised of four sections was originally submitted to the Environmental Protection Agency (EPA) on December 3. 1986. The four sections of the work plan consisted of:

- I) Site Management Plan
- II) Quality Assurance Project Plan
- III) Health and Safety Plan
- IV) Community Action Plan

Modifications to the Soil Investigation Plan were completed, and final modifications were submitted to the United States Environmental Protection Agency (EPA), Minnesota Pollution Control Agency (MPCA) in September, 1988. The field exploration and laboratory analysis of soil samples obtained during the field exploration were completed in accordance with the Soil Investigation Plan and Quality Assurance Project Plan for the Soil Investigation Work Task as outlined in the above documents.

The exploration consisted of the drilling of fifteen soil borings (B-1 through B-15). The locations of these borings was determined by the City of St. Louis Park whom also staked the borings and provided utility clearance for each borehole location. The City of St. Louis Park also secured access permits for these fifteen borings. The borings were drilled within an area bounded by West Lake Street on the north. Monitor Street on the east. Taft Avenue on the west, and Minnehaha Creek on the south. STS Consultants drilled and sampled the fifteen borings in accordance with the Remedial

Action Plan under the guidance of an ERT (ENSUR) representative. The fifteen borings were drilled between the dates of September 6. 1988 and September 23. 1988 to a minimum depth of 35 feet. The maximum depth of borings was 55.5 feet.

The subsurface exploration procedures used and the sample retrieval procedures were in accordance with the Remedial Action Plan. Section 11, developed by ERT, Inc. These procedures were used to minimize any affect on the existing chemical concentrations of the soil. The following procedures were used during the subsurface exploration procedure.

- Only 40 hr. safety trained workers were allowed near the drilling activity.

 Level D safety with splash protection was followed; Level C standby.
- o All drilling and sampling tools were steam cleaned prior to drilling each boring.
- o The 2" O.D. split-barrel sampler was steam cleaned and rinsed with methanol. hexane, methanol, deionized water and air dried in a contaminant-free area. The split spoons were then wrapped in aluminum foil until used. This process was completed prior to each use if soil was contaminated. If no contamination was noted, the steam cleaning was excluded from the sequence.
- o Soil samples weighing approximately 200 grams were obtained in general conformance with ASTM Specification D-1586-84.
- o No solvents or greases were used on the drilling tools.
- o No smoking was permitted within 100 feet of the work area.
- The Geologist immediately obtained possession of the split-spoon barrel and completed accurate and defensible sample preparation including soil classification in accordance with Unified Soil Classification System. HNU Photoionization detector readings, and carefully noted all odors of soil samples.
- o A new pair of disposable latex gloves were used for removal of soil from the split-spoon sample barrel.
- o Only I-Chem 500 ml glass amber factory cleaned and sealed containers were used.

- o Stainless steel sampling tools were used to prepare soil samples for the laboratory analysis.
- o Duplicate samples were collected by splitting the sample longitudinally with a stainless steel knife, and each half was placed in separate I-Chem sample jars.
- o All samples were cooled to a temperature less than 4° C. and shipped to the analytical laboratory on the same day by the Field Geologist.
- o All samples were accompanied by a Chain-of-Custody record at all times. For all possession transfers of samples, the individuals relinguishing and receiving signed, dated and noted the time of the transfer. Other information included on the Chain-of-Custody record include:

Sampling site identification.

Sampling data and time.

Identification and sample collector.

Sample identification.

Sample description.

Number of containers per sample site.

Analyses to be performed.

Which samples would not be analyzed but held for possible analysis on a later date.

SOIL INVESTIGATION

The Soil Investigation Plan provided that fifteen borings would be drilled. Each boring was drilled to at least 35 feet. In the case that contaminated soil existed at 35 feet, the boring was continued until uncontaminated soils were encountered.

The intent of the soil exploration plan as defined in the Remedial Action Plan, was to obtain 25 samples from the fifteen soil borings. Of these 25 samples, 10 were to be obtained from samples classified by the sense of smell as "clean" from different lithological soil types for background levels of benzene extractable hydrocarbons. A total of thirteen soil borings and 23 soil samples were classified by the sense of smell as "clean". Only boring 2 had mild creosote contamination and boring 3 had slight creosote contamination. The terms mild and slight describing qualitatively the level of creosote contamination of soil samples was defined in the field by Mr. Bill Gregg of ERT on September 8, 1988 during the sampling of borings B-2 and B-3. Sample #5 a gray sand and gravel was the contaminated soil analyzed in borings 2 and 3. The 23 soil samples that were classified as "clean" were taken from seven different lithological units which were identified in the soil borings. Table 1 in the Appendix lists the various lithologic soil types sampled for analysis and the distribution of the analysis among these soil types. These units are:

- Peat
- 2. Organic silt
- 3. Clay and silt
- 4. Brown sand
- 5. Gray sand
- 6. Glacial till
- 7. Silty sand and gravel
- 8. Surface fill

An eighth unit, surface fill was also identified but no soil samples were collected of this unit as instructed by an ERT representative. The surface fill was observed in all borings except boring 8, where no fill is thought to exist.

Figure 2. Generalized Surficial Geologic Column (ERT. 1983) depicts the morphology and stratigraphic position of the geologic units observed in most of the fifteen soil borings.

SUBSURFACE EXPLORATION PROCEDURES

The borings were drilled with a truck-mounted Diedrich D-50 drill rig operated by a two man crew with an on-site STS Environmental Geologist. The borings were advanced to full depth using continuous hollow stem flight augers, except borings B-1 and B-2 in which rotary drilling methods using bentonite drilling fluids were used below 19.0 feet. Soil samples were obtained using the 2" O.D. split-barrel sampling procedures in general conformance with ASTM Specification D-1586. "Standard Method for Penetration Resistance and Split-Barrel Sampling of Soils". Field logs of the soil and groundwater conditions encountered and the sampling procedures used were maintained by the on-site Geologist. Water levels measured while drilling are reported on the lower left corner of the boring log. Water levels measured through the hollow stem augers may not represent stabilized water levels. A copy of ASTM Specification D-1586 along with enclosures describing general drilling and sampling procedures are included in the Appendix. Deviations to the general procedures were made to follow the Quality Assurance Project Plan (QAPP).

A troublesome problem encountered in the saturated granular zone was the soil raising up into the hollow stem augers. This is due to a lower hydrostatic pressure inside the hollow stem. The water and soil under a higher pressure move up into the hollow stem augers equalizing the pressure difference while drilling ahead. In order to minimize the heaving effect of the soil and water, a flex plug (see Figure 1) was installed in

the hollow stem drilling bit. The flex plug stops soil but allows water to rise into the hollow stem augers. In conjunction with the flex plug, water was added inside the hollow stem augers creating a head pressure. These steps minimized the amount of soil rising into the hollow stem augers. In the event heaving of soil did occur, jetting with City of St. Louis Park city water was used to lift soil up and out of the inside of the hollow stem augers. The jetting was completed with care so as to minimize any change in the chemical concentration of soil to be sampled. These methods were approved by the on-site ERT representative.

All water added and/or jetting water was carefully documented on the drilling logs. If not noted before sampling on the boring logs, jetting and/or adding water inside the casing did not occur. On the two borings which drilling fluid was used a plastic bag was placed over the split-spoon sampler and sealed above the sampler on the drill rod with duct tape to prevent the drill fluid from entering the split-spoon sampler.

All cuttings from the soil were placed in MnDOT approved 55-gallon barrels, sealed and stored in the designated area. Each barrel was labeled with the boring number and the date of barreling.

At the end of each boring neat cement grout was pumped through the drill rod to the bottom of the drilled hole until undiluted grout exited the top of the hollow stem auger. After the removal of each 5 foot section auger, grout was poured in the top of the augers so as to ensure completely grouted borings.

APPENDIX

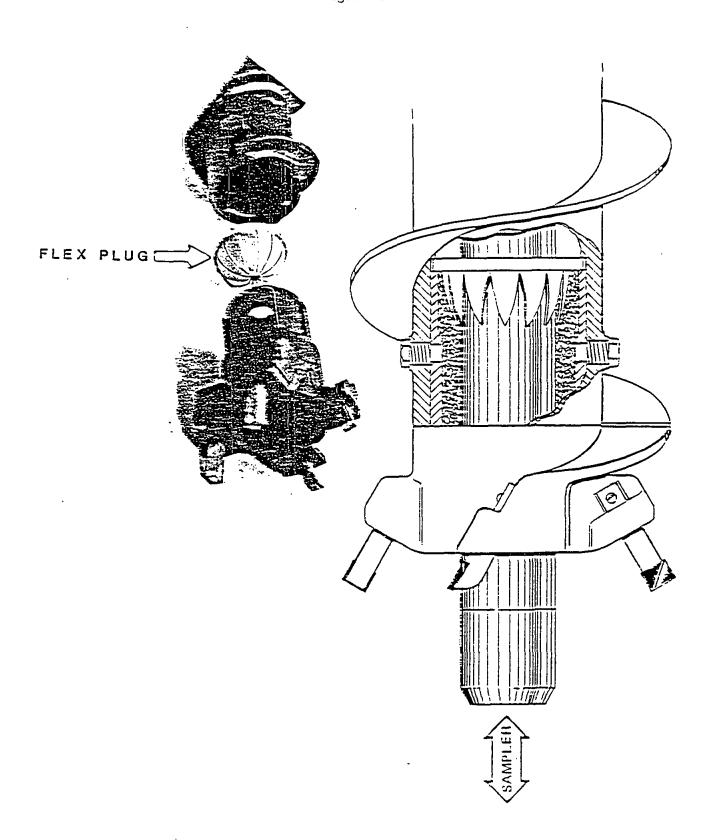
- 1. TABLE I SUMMARY OF SAMPLES ANALYZED
- 2. FIGURE 1
- 3. FIGURE 2
- 4. INTERPOLL TEST RESULTS
- 5. CHANGE OF CUSTODY RECORDS
- 6. STS GENERAL NOTES
- 7. DRILLING AND SAMPLING PROCEDURES
- 8. ASTM SPECIFICATION D-1586
- 9. UNIFIED SOIL CLASSIFICATION SYSTEM
- 10 SOIL BORING LOGS (B-1 THROUGH B-15)
- 11. EXHIBIT A SOIL BORING LOCATION MAP (Map Pocket)

Table I

City of St. Louis Park

Summary of Sample to be Analyzed for Benzene Extractable Hydrocarbons

Boring Number	Boring Description	Peat and Organic Silt	Clay. Slit		& Grave	l Glacial Till	Silt. Sand Gravel
B-I	Clean	S #3			S #6	S #5	
B-2	Mild creosote contamination				Mild creo- sote S #5		
B-3	Slight creosote contami- nation				Slight creosol odor S		
B-4	Clean hole	S #2, S #3. S #4					
B-5	Clean hole				S #7		
B-6	Clean hole	S #4			S #6		
B-7	Clean hole					S #6	
B-8	Clean hole					S #6	
B-9	Clean hole		S #2				S #8
B-10	Clean hole			S #6			
B-11	Clean hole			S #3			
B-12	Clean hole	S #3			S #7		
B-13	Clean hole	S #2, S#3					
B-14	Clean hole				S #5		S #11
B-15	Clean hole			S #4		Dupli- cates S #6	



200

The state of the s

TO SE

Š	ŭ	Ñ	S	is
7	1		- II	
	9	A)
b			-	4
K	€	A A		1

Samples Shipped Via St. Samples Shipped Fron City of St. Circu.
Samples Shipped To Filkell Complete Shipped To Filkell Complete Number THE

11 м 77			Reco	
· .			Custody	through
DATE 1-12	Hinke		of	
	1771-1117		Chain	
Nº 6461	Sealed for Shipment by	ATTENTION OF WELL	Project	Series

-	Pro lect	Pro Sert Man / Description	Dacreto+	3										Nomo	200 30	2000	10/	4 00	(
	, , ,		de lace de						•					2	/ /sviaiduns in amin	ילי ושולו	Bio / /	משטות נוון על אי	,)					
	Chut SI	That St. Konstart		11/11	7177	4114	. 3	5:11	Soil on Whenlie Sinthit Pier	Rei	11 tal	74		10	Son Tohnson	Tin		(1): 1(1)	1/1	+				
<u> </u>				Sa	Sample	Typ	(5) ac	_										-					_	
	Sampling Point /	Date	Time)]=\ 	ne:		Follo			Sample		Location			Analyses Required	s Requi	hed	Number	mber	Commer	Comments on Samples	amples	Labo	Labora-
	Field) a		Tet IIO)S											Con-		i İ	Š)# []
	ID Aurher	•			a::													tain	tainers					
) 		9251)(12.5	Jay:																
					15		-											-	1					
181	5#3	1.1.6	1400				7-		Pril	11 11		:		1247	Parzene extene libe milaster	41771	11.14	- 1-17/5						
13.1	5:11.5	4-1-	15.49				- >-		1/200	7	1 1				_			_						
	5.11.6	4-1.	11.77	<u>!</u>			\		7		-				1								<u> </u>	
=	7 11		1/4/2	+	Ţ	1	+	1	77.7	F	7				.			1					 	
<u>E</u>	11/	7-6	1543					(- !!-	17				-			i	140	Jugle	Sample of 11.11.1 +11.1	1,17	_	
		-								<u> </u>	-							•	•		/			
														12/11	July	13/100	SALVIA	11	7	1112101	1010	1/ 1/1/		
	Renarks	Renarks on Site / Site Conditions	te / S	ite	S	ndit	lons	10				1/10		1/1	1.1.1	- F	0"/	- 	17	tri in in	5/0/10	11.3	 	
	1111 4.0	All somethe and from Being #	9.7	- (7	301.1		14				13)//3	200		1	, ,		77,		ck the	5 = 5	1.4	5#3	747
	// 11/1	, ,, ,,				,				-		1,0	(il)	1116	t David /	". Y . T.	11.	ch dià		No Plea	4°C at the laboratory to ferring inc. No received white somplies	1.50.00	` • : <u>`</u> `	
	7		•		,	-	_				(-	•		 -						-		2	
	1,121127	1201200 28 Land Libbe 114 descentions 300 des 12 5tores are 51 1 110 548 11 1600 1600 11 1	lene ful	عِ	17.1	קנהד	1/11/	<u>~</u>			2	1/5/17/14	27	5/13/16	Jule:	SIF	1,5,	17/17/	THE S	187	// <i>6</i> /2011 S	J. 11.14.	/	
~~	Samples	Relinguish	led by				**	Samp	səlc	RACE	lved	86				Commer	115					/ gate /	, Time	
	1/1/11 1/1	1/64 3/11/1/20						1,	_	112	/ ر	16.7.46	_ <i>j</i> !									d/2/23 0130	00,00	.,./
	Samples	Pelinquish	yd by		İ		<u></u>	Samples	. '	Rece	Received by	bý				Comments	ıts					note/	Tine	
-	17:77	iting for	7	Ì			<u> </u>		11/1	A.57;	7.77	j										25.11		
-	Samples	Samples Relinquished by	red by				<u> </u>	Samp	Samples Radelv	Rade	ived by	by				Comments)ts					Date /	Tine	
	Hearis of	Means of Delivery		ļ.	i	i	i	!			1	[:		S	ָר ע	- - -		Spole Intoct: TYES			NA	
																さいつ	חח	3 =	֡֡֡֝֝֡֝֡֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֡֓֓֓֓֓֓֡֓֓֡	1	:]	_		_

Original and yellow capies to tak. Pink copy for project file. Lab forwards campleted original capy to STS with analytical results, tab retains yellow capy. S12 ENV 01 1-86

	\simeq
	RECORI
	$\frac{8}{2}$
	CUSTODY
	Ď
•	
	·
	Z
	\preceq
	一
	_
	FIELD CHAIN
	I
	\
	Z
	7
	⊢
	二
	IDENTIFICATION
	Щ
	L L
	닏
	SAMP
	A

So	Sa	So	ST	-
-216				l
	- • •		#§/	
	E			1

Samples Shipped Via
Samples Shipped To
Samples Shipped To
STS Project Number

2	Sealed	ATTENT			
,					
57.6	575	To leaded	H LA Olile	:TM	

ПИЕ 1200			Record	
19TE 2-8-52	115/6		Custody	through.
TE 2			of	
ψú	1/10	- c"/12	Choin	
	ا ا	117	بد	
6230	Shipment	F	Project	Series
Nº Nº	Sealed for Shipment by	ATTENTION OF		

Project Name / Description	gwe / [lescripti	ug														Nor	to at	S	mple	Name of Sampler(s) /	Signi	Signa ture(s)	\		
(it, it	5/ 16.13	RK															<i>";</i>	É	-	101/1	Man Tollark	<u> </u>			+	
			So	Sample	-	(s)adk]	5) =	_	<u> </u>		ĺ											F	,	L		
Sampling Point /	Date	Tine	Nell		Ter.	Spino	Leilo	<u> </u>	i		Sam	mple	; L	٥٥٥	nple Location	_		Ana	lyse	S.	Analyses Required	ठ	Number	<u> </u>	Comments on Samples (preserved, etc.)	Labora- tory
Field ID						13)	s																Con- toiners	vı		# G
Number			TOTINOM	gnitzixa izatauz	MOZIGA	91.50m	lios	other																		
1523716	3-6	1000				 	\vdash^{\times}	-	_	12	1	16	1/1)	15%	1-11.5/26	12.	7	100 /101	111	11/				<u> </u>		
5.25410	9-8	10,01					\sim		_	?;		11/	13/84 -11	\ <u>```</u>	1.55	1.55/1		110114		10						
11 #5 63	4-6	02//					<u>```</u>			17/	1	51.	19-505	75,0	/ >	1155		70:17		166						
1525412	9-8	1,021					<u>,</u>		/	12	1	1,5	-555	2.	_	18812		none		1777)			_			
835# /	9-3	15.25					X		,£	83/	10	0-1,	1.51		, s's <i>(</i>			Test		1/4/1			,			
R35#2	9-8	1535					<u>×</u>		\mathcal{Q}	B31	14/	3	7	,	3	5-6 1552		Moite	Q.	See.			_			
Renarks on Site	on Sit	\	Site Conditions	ت	anc	=======================================	6	ហ)					

Samples Relinquished by	Samples Referred by	Conngnts	Date / Time
1/2~\@\\\!\!\\	12x1 hr 167,c		1/1/28 0386
Samples Relinquished by		Comments	Date / Time
- sty miss.	a Busines		
Samples Relinquished by	Samples Received by	Comments	Dote / Time
2			
Heans of Delivery		Seals Intact: Tres Thin MA.	NO N.A.

Unginal and yellow copies to lak. Pink copy for project file, Lab forwards completed original copy to STS with unalytical results. Inb retains yellow copy. STS ENV 01 1-86 11361

RECORI
\mathcal{C}
ليا
V
>
\Box
in
~
CUSTODY
CHAIN
H
\leq
工
\Box
FIELD
Ĺ
\
_
\leq
7
ENTIFICATIO
_لــا
三
ENT]
Z
Щ
ID[
<u> </u>
ليا
P
Σ
A
()

1

A Marian

Witness &

1

P	
	1

575	, -	94019 1	THO
Samples Shipped From	Samples Shipped To	STS Project Number	SIS Project Manager
			1

7:2:T 3HI1			Record	
DATE 4-5-53 11	DOW JEHNSTON		Custody	through
re 4-	New Y		of	
DAJ (700	7357B	Choin	
Nº 6462	Sealed for Shipment by	ATTENTION OF	Project Chain	Series
ľ				

			•
Somples Relinquished by) % (Comments	76/38 /25 9810
Samples, Rylinquished by	(Symples Received by	Comments	Date / Time
Samples Relinquished/by	Samples Received by	Comments	Date / Time
Means of Delivery		Seals Intact YES HIII	NO N.A.

Unignation and yellow copies to tak. Pink copy for project file. Lab forwards conpleted original copy to STS with unalytical results, tab retains yellow copy. STS ENV 01 1-86

Sec.

	SAMPI	Z F	IDE	IDENTIFICATIO		OI.	AT		\	H	/ FIELD	CHAIN DF			CUS	CUSTODY RECORD	REC	[]R]
			Samples Shipped Via Samples Shipped Fron Samples Shipped To	s Ship Shipp S Ship	Shipped Via Shipped From Shipped To	A VIO.	STS SPS Jaku	1///				$N_0 = 6229$ Sealed for Shipment by -	6229 Shipmer	nt by	DATE	DATE 7-7-85	ŀ	TIME 1615
	R		SIS Project Number SIS Project Manager	o ject o ject	Numk Manag	Jer –	17.0	1141						اب	Chain	of Custody through		Record
	Project Nor	/ a'//	Description	tion	50,7	111/	38/15 11	1.i. R	Rik tur	ţu/	Name o	Name of Sampler(s)	I\	Signa ture(s	1/14			
	Sampling Point / Field	Date	TIME	Se llew garder and ter	⊢ ua:	O Tailoz		Sample	Sample Location	tion	Α	Analyses Required	ured	Number of Con-		Comments on Samples (preserved, etc.)	amples etc.)	Labora- tory [0 #
	1D Number				surface wastewat	waste soli	other				· · · · · · · · · · · · · · · · · · ·			toiners	Ņ			:
	B2 (1) A	J. 9-7	1700				X X	14. in #2			Pener	Remer Plants 14 14 Mailes	14,12 41	1	12:14	Dilli, Plust		
~	177	=	1			7,	100	/57-0/z	<u> 155/57</u>		- MEN -	Mark - Mald	.		7			
7,7	2/1/2	= =	////			X `	12 F	445-60 552	25/20/	7;	रेगाला	110112 - 11011		\\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\				
741	5#5		0/2/			\ <u>></u>	70 -07	70	0-2115/555	7 - - - - - -	12008	Rank To 11014	1. 616	1	39			
13:5	546		9,	1 1		\ <u>\</u>	182	1-52	-26.5/256	556	1)0dZ	1/14/ = 1001		,				
, 37 TE, 12	Renarks	5	Site / S	Site	Conditions	tions -	182	130	15/5	472	7000	1/4/ 4 /6/		-	<u> </u>			
, , ,	12/18	"	1575				777	35-3	23(2)	838	dede	17077						
								_	•									
	Samples Re	Relinguished by	yd bar			,	Samples	Ref	ed by	,		Comments	nts	()			Daye / Time	
	11.7	11115/611	1				CX.	ダンショ	2/01	$\Big \Big $		7/2	477		12 66 2 50	0	-11-11-230	123 cm/00
	A. Galoron		200			_		Salara u	And Jac				10+4				T / O+ - U	-

Original and yellow copies to tak. Pink copy for project file. Lab forwards completed original copy to STS with analytical results, tab retains yellow copy. STS ENV 01 1-86

N.A.

Seals Intacti Tres

Date / Time

Comments

Samples Received by

Heans of Delivery

1.7.6

	۲		7
		ニー・シ	/
	5	Ξ	_
	L		_
	7		`
	Ĺ	_	J
	ì	,	1
	_	÷	_
	C	<u> </u>	_
	_		
	`	_	
	1	_	_
	2		2
	_	_	_
	L		
	L	_	_
	Γ		
	1	/	ጎ
	Ľ	_	:
	Ξ)
	7		Ś
	Ĺ	_	J
		<u>-</u>	
	L	•	_
	Ξ	_	_
	L		J
	_		_
	~		_
	_		7
	<	3	_
	_	_	_
	_	1	_
	1		١
	_	_	J
		,	
	_	_	
	Ĺ		1
			i
	_	_	J
	- I		ı I
	Ĺ	Ļ	<u> </u>
	Ļ	L	 -
	L		_ _ _
٠	L		<u>ן</u>
	L L	_ _ _	 - -
	ī L L	_ _ _]
,	L L	_ <u> </u>	111 -
	_ L L		
٠	_ L L		
	\ 	<u> </u>	` -
	\ 	<u> </u>	` -
	\ 	<u> </u>	` -
	\ 	<u> </u>	` -
	\ 	<u> </u>	` -
	\ 	<u> </u>	` -
	\ 	<u> </u>	` -
	\ 	<u> </u>	` -
	\ 	<u> </u>	` -
	\ 	<u> </u>	` -
	\ 	<u> </u>	` -
	\ 	<u> </u>	` -
	\ 	<u> </u>	` -
	\ 	<u> </u>	` -
	\ 	<u> </u>	` -
	\ 	<u> </u>	` -
	\ 	<u> </u>	` -
	\ 	<u> </u>	` -
	\ 	<u> </u>	` -
	\ 		` -
	\ 	<u> </u>	` -

TO L

	E SOLAN	
	VA)
		á
P		4
		4

Samples Shipped Via Strinis Samples Shipped From Strinis Samples Shipped To Tistes Its STS Project Number 310

7.1.7	St lenis Pull	Jules 1/21	C/8.75/1	7///
δl ∨lα	From	d To	mber	ager

Project Name / Des	Description		Name of Sampler(s) / Signa	Signa ture(s).	
C. L. at 57 12415	Park 1 Sil 10	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	زير		
	Rample 1				
Ing Date	WELL	Sample Location	Analyses Required	Number Comments on Samples of Con-	es Labora. tury [0 #
ID Number	monitorin Surface Surface Mastewa	Jost Parta Parta		toiners	
11 38-4-12 145 551		 i	1640 (6/1)		
11 17/15 11 12	1245	1/3/45-6/552	110ne 1/2/!		
11 11 11 11	1256	1/583	110114 1/2/		
115541 11	7051	11.7584	110.11		
17.55 \$ 11 15	7,5	1 15/115-21/ 555	11516 (4/1		
1155 16 11 13	1328		11011		
Remarks on Site	/ Site Conditions				
-	1333	1 185/245-31/557	Kinterpet K. J. C. M. leade.		
(35 5 ps 11 13	348	25	11011-2 1/6/		
Samples Relinquished by	by	Samples Recetygd by	Comments	Dat	Date / Time
		The Church			1/1/1 18/1/1
Samples Relinquished	by (Samples Received by	Comments	Dat	e / Tine
Samples Relinquished by	by	Samples Received by	Comments	Dat	Date / Time
					· ·
Means of Delivery			Seals In	Seals Intact: TYES THIN	N.A.

liriginal and yellom copies to lak. Pink copy for project file. Lab forwards completed original copy to STS with analytical vesuits, lub retains yellow copy. STS ENV 01 1-86 1001

SAMPLE IDENTIFICATION / FIELD CHAIN OF CUSTODY RECORD

10 mm	
Þ	

Samples Shipped Via 575
Samples Shipped From 574
Samples Shipped To 74
STS Project Number 715

716/4 13 716/4 13 1160	5.6. 21	
140 B	11 to 10 11	Sealed F
THO	940/4 13	
	7/10	

TIME 14.36	Record
DATE G-1-55	Custody
TE SO	of
5	Chain
Sealed for Shipment by ATTENTION OF	Project Series
Sealed for St	

Project Name /	/ Description			Name of Sampler(s) / Slana	Signa ture(s)		
St land Poll	1 Sail 1114	"shugh	South of Keil, to		D. (C/1/4)		<u>.</u> <u>.</u>
Sampling Date	Time Samp	Type(s)	Sample Location	Analyses Required	25	u	Labora-
Field	n 6	Ter ilos sol			of (preserv	(breserved, etc.) t	tory ID #
Number	6up	G GMC.			tainers		
	inom i	auto los tsom					
17-6 175 175	0,5,0) X	1 35/51-0/19	Hene Hall	/		
11 2/18 11	03/50	, ,	03/145-1155	Benzone extratable Halorades	/ >		
11 118481	7,040	, X		Price Patientile Mollocartus		-	
11 1.1.5.1.9	0421	\ \ \ \	74	But at of hist blothal och by			
11 SHS 11	0428	, , , , , , , , , , , , , , , , , , ,	18851	1/4/ 2000	555/12-51/18	/555	
11/5/16 11	51,45		34/245-26/556 110112		·		:
Remarks on	Site / Site Co	Conditions		Ì			·
15-1547 11	1001	X X	4/285-31/557	11611	5 Syprifoling 2	tulla	
11/2/18/11	5101	7 7	\sim	518 none 1611	, /		
		00	to Outhinks	Du Minks tulo, on 14/745-31/617 Hell	1-1/617-1	11/1	_
Samples Relinquished	shed by	Sanples	Recei	COMMENTS	;;	Date / Time	Ì
	20	T.	<u>ئ</u>			1/1/1/2012	
Samples Relinquished	shed by	Saldwas	les Received by	Comments		Date / Time	
Somple Rolling Parkey	704	Č	c				_
	2	s aidens	ies <i>Kecelv</i> ed by	Lomments		Date / Time	
Means of Delivery	ry			7 2 2 2	C		
				ur sinac		LIMI LINA.	

Ariginal and yellow copies to tak. Pink copy for project file. Lab forwards completed original copy to STS with analytical results. Iab retains yellow copy.

The second secon

The state of the s

SAMPLE IDENTIFICATION / FIELD CHAIN OF CUSTODY RECORD

	~ R

Samples Shipped Via
Samples Shipped From Lift
Samples Shipped To
STS Project Number
STS Project Manager

973	Chat Wenis Fill	1 6.1. 16/1	11/2/01/2	J.W	
₫	٤	٥	<u>_</u>	<u>.</u>	:

Sealed for Shipment by Med 10 Milk.

ATTENTION OF 10 Chain of Custody Record Series through

Chit Stous All Chairs	1 56,1	Sundle sentlothich tel	Nome of Sampleris) Signatureis)	(5)8.	
10 to 1	Sample Ty		My beginned negations	2 4 00 mm 2 J	
P	well			of (preserved, etc.)	e'(C.) tory [I] #
Number Number	existing wastewa waste	other.	7	יוטפרי	
B241 G-12-88 1425		X (27072) 58	1/1:3//		
157 5/12 1435		17/4,5-6" 55	1/6/1		
115/13 1439		1 1/2/9/5-11/55	1/0/1		
1324/4 1450		13/145-16) 41	1791		
13/2/15		112/195-21/55	Hoki		
1875.11		11/145-26/55	Bather extentible Halocarken		
Rémáriks on Site / Sit	Site Conditions	-			
187511 1520		131295-31)55	119/1	/	·=
62918 4 1534		1 62 (34.5-36) 55	17011		
Samples Relinquished by		Samples Received by	Comments		Date / Time
Can Phaston		Billet			473-46 1656
Samples Refinquished My		Samples Received by	Comments		No te / Time
Samples Relinquished by		Samples Received by	Comments		Date / Time
Heans of Delivery			Seals Intacti Tres	LC-tı YES IIII	III []N.A.

Driginal and yellow copies to tak. Pink copy for project file. Lab forwards completed original copy to STS with unalytical results, tab retains yellow copy. 31S ENV 01 1-86

SAMPLE	إيا	IDENTIFICATIO	1.1			بــا	Ē	Ü	Ø	<u> </u>		\mathbf{Z}		\	<u> </u>]]	/ FIELD			CHAIN OF	<u>ー</u>	<u> </u>	\Box	JST	CUSTODY		RECORD	IRD
	T	Samples Shipped Via Samples Shipped From Samples Shipped To	ν γ ν	다. 보다.	ppe sed	ر م ہے د	Via Lo.			2/2/2	777	1.4%	9	7/7				f. 3	Seale	Sealed for Shipment by	6380 Shipmen	\(\frac{\frac{1}{2}}{2}\)	M.	AT.	1-12.	TIME	, i	1630
		STS Project Number STS Project Manager	o Je	tt	ŹŁ	umk nag	er Jer			7]		32.9						1 . ,	-		Project Series _	ect 's	Chain	of (+	Custady hrough	Record	3
Project Name	1. 7.	/ Description	tion		17	Thania!	164		(3)	_	18. W. Ill.	1 1/2	1 73		south Polleton	tu,	Nar	5 C	f Sor	Mane of Sampler(s)	Sign	Signorture	(5)	11/				
<u> </u>			S	ample	ple	1'	pe			4	1	1		j	 		<u> </u>					_					-	
Sampling E	Date	Time	Mell	ηja	1910	Jië	Tailoz Failoz				ž	ldma	а Т	900	Sample Location	_		And	ılyse	Analyses Required	D 0	Number	per f	Comr Cpr	Comments on Samples (preserved, etc.)	Samples J, e.tc.)		Labora tory
ne or			Su.		A a	ם בפ																toiners	ers				-	 = =
Number			TOTIROR	iui‡sixa	⊃aJ⊶ns	MOLSOM	a1.50#	lios	other					`														
1-13 1/5178	7/-	1018						>~		O.E.	17	0			12		77	16172		11/0/1							<u> </u>	
11 542	. —	7501						_><		77	2	7)=		2	1	17	Mode		17:77								
16h 5 W3		103/								\ <u>\%</u>	p'	EX.	[1, -	口	12	~	И	20011		1/4/1				1,11	1501 Mil	,		
160.5114		1094						_>-	7	2	な	77,	` 니	<u> </u>	3	7	Ku	1200	Kazeneex	1. J. H. 11.	1/2/4	1		Liber	1,50/54H			
16.545		1045						_>	Ī	1,7	<u>``</u>	//4.5	1	\sim	\leq	Ž,	Ü	Mouse	· ·	11/4/1	<u> </u>	-		lube	(1. 1) only	1		
7 45971		30						-7	Ī	S.	户	77	7.45	7	<u> </u>	36	M	700		1/4/1								
Renarks	2	Site / S	Ste	- 1	اق	Conditions	<u>ئ</u>	2		_ {		ļĮ			\ 1							1]					
1,(6,5)/1		101						7		7	-5	(25		77	72	2/	11011	777		17511							<u> </u>	
134331	}	1131	_					<u></u>	ا ا	77	4	过	12	7	(,)	200	7777	16116		WH		1	-		\		<u> </u>	ĺ
Se	1/ Ber	Soilburn H	1	(3)	2	3-66	2	_)										•		•				
Somples Reli	Relinquished	ed by						S	O III	Samples	1	Scel	Received by	ģ						Comments	S					Do te	/ Time	
1/211/2011	chiis fra	Ŋ			į			- 1	Z	Billshape	77	2	12/2	1												9-13	7-13-86 1656	26
Yamples kel	ากคุนไรท	idd by						<u>^</u>	o me	Salc	 	cel	ved	ģ						Comments	St.					Date	/ Time	

4

ļ

firiginal and yellow copies to lak. Pink copy for project file. Lab forwards completed original copy to STS with analytical results, lab retains yellow cupy. STS ENV 01-86

N.A.

트

Seals Intacti Tres

Date / Time

Comments

Samples Received by

Samples Relinquished by

Heans of Delivery

DATE 9-13 TYP TIME 15 36. SAMPLE IDENTIFICATION / FIELD CHAIN OF CUSTODY RECORD

さい 丁二年 野田の

五年

Š	Š	Š	S	Ċ
7				
		4		. A
R	90			4
(1)				_{i}

242	(1/10/17	thute,	12/0/15	JAN
imples Shipped Via	mples Shipped From	imples Shipped To	'S Project Number	S Praject Manager

7 6 11-1	Nº 6293
0 25 LOUIS 1011	Sealed for Shipment by _
16. All	ATTENTION OF
11.10	Project
<i>(f)</i>	Series

Record

Custady through

of

Chain

Project Name / Description	•	Name of Sampler(s) / Signa ture(s	ure(s), //		Γ
City of Stlenis Park. Claimed Soil	Gandler Rill of Rich til	~~			
Sample Ty	,				
oter 1910	Sample Location	Analyses Required		Comments on Samples Labora- (preserved, etc.) tory	-۵۰
A Gu			Con-	9	#=
eniterm eniterm gniters gniters	atsow nos		s Javio		·
	>	P1 94			
3611 145	169 (45-6)	1/9/			:
1,50,7		1.40/1			
1,54541	139 (45-16) 554				-
13 4 6.45 1473	139 (195-2N, 555	1/6/1/			
1974	134 (2454) 556	His/d			
Renarks on Site / Site Conditions	-	H):		
15:15:17 (1456)	(39 (24.5-31) 557	theld			
1, 6 548 1 145-5-	1 09 (345-36) 555	345-36 558 Monane Exhibitile Holowhen			
Samples Relinquished by	Samples Received by	Comments		Note / Time	
May Tohas ton	.77)			373-86 1656	.٧
Samples Rélinquished hay	Samples Received by	Comments		Date / Time	
Samples Retinguished by	Samples Received by	Commonte		D + 0	
		n		au / as on	
Means of Delivery		Seals Intacti	YES	NO N.A.	

Original and yellow copies to tak. Pink copy for project file. Lab forwards completed original copy to STS with analytical results, lab retains yellow copy. STS ENV 01 1-86

Ł

Service 1

SAMPLE	IDENIIF ICALII	AIIUN / FIELI	ILID CHAIN LIF	IF CUSTODY	RECORE
os So		City of Stfanis Poll	Sealed for Shipment	T by fresh striken	TIME /5/30
	Samples Shipped To _ STS Project Number _	940140	ATTENTION OF	11.674 An	dy Record
al	STS Project Manager _	777	Series	s through	hh
Project Name / De	Description		Name of Sampler(s) / Signi	Signa ture(s)	
Sampling Date Point / Point / Pield In	well a	Sample Location	Analyses Required	Comments on (preserved	Samples Labora- etc.) tory [D #
Number	monitoring existing surface wastew soll	Jay to		tainers	
68 47 9-1382 1	10-1C X	188 (0-1.1) 581	now Hald		
15.4.5.42 11	1	18 (45-67) 412	11000 110/1		
118543	1011	118 (95-11) 43	110112 14/14		
11 -1-146.86		188 (145-147) 584	Jane 12/1		
18588		13/145-21/955	Mens 16 Kl)	
i i	117	118 (245-24) 956	now ////		
13x 577	/ Site Condition	AF 125-31, 457	11911 000		
11 1/2 1/3/1/2/11	135 N	138	14012 116/3		
ייייןטר	Z.				
Samples Refinguished	٠ د	Samples Received by	Comments		Date / Time
Samples Relinguished	>9	Samples Received by	Common	1	7-15-45 16.56
			# TUNE TO THE TOTAL TOTA		Date / Ime
Samples Relinquished	βγ	Samples Received by	Comments		Date / Time
Means of Delivery			Seals In	Seals Intacti Tres Thin	n N.A.
					l ————————————————————————————————————

Original and yellow copies to lab. Pink copy for project file. Lab forwards completed original copy to STS with unalytical results, lab retains yellow cupy. STS EIM 01 1-86

100 PM

Mari

AMPLE	Samples Shipped Via CATION Samples Shipped From Culpton Samples Shipped To SIS Project Number	1 / 10	FIELD CHAIN DF	F CUSTODY By fee Schutt	CUSTODY RECORD 10 DATE 4-21-5/4 TINE 4-3C	36/2 36/2
roject Name	Description	rice Souther Killy	Name of Sampler(s) / Signa	Signoffire(F)		
Sampling Date Point / Fleid ID Nurber	Memorinom well and an architecture water and record and architecture water and architecture and architecture and architecture and architecture and architecture and architecture architecture and architecture archit	Sample Location	Analyses Required	Number Commer of Gre Con- toiners	Comments on Samples I.	.abora- tory ID #
17-15 7	\	(0-15) 551 (4.)-(5.52.	1000			
9-21	1/5 25/	1 655 (1-5hl)	10/5 10.00			
12-69	15.46	(14.5 2D 555 -1)	6 H 2017			
enarks on Si	Site / Site-Conditions	100000000000000000000000000000000000000				

Original and yellow copies to lab. Pink copy for project file. Lab forwards completed original copy to STS with analytical results, lab retains yellow copy. STS Elly 01 1-86

N.A.

YES | |

Seals Intacti

Date / Time

Comments

Sangles Received by

Relinquished by

Samples

Comments

Comments

Samples Received by

Samples Relinquished by

Heans of Delivery

together in the second

ここと ここの 一変を

Sar	Sam	Sar	STS	STS
		7		
	-	4		4
K	45	y A		4

Samples Shipped Via

4.15	1. K. J. 51 Mais Par K	July 1/10 /11	fl block,	I M	
d	5				

Seoled for Shipment by Control

Project Name / Description		Name of Sampler(s) / Signature(s)	trire(s)	
1.1. 2 St. Pain Port	is souther fish two	Phyll CTilust		
L aldmos	(5) a			
ell ater	Sample Location	Analyses Required	Number Comments on Samples of (preserved, etc.)	Samples Labora- etc.) tory
A Gu			Con-	=======================================
Transport of the contract of t	harto.		toiners	
	7<	1/01/ 1/1/		
5-115/2 1 1636	18/1/6/5-6/58			
11 17 18	8/1/2/5-1/1883			
1/1/1/1/1/25	155(91-511) 1181			
850/	11/1/1/1/5/5/5			
13/15/16	11/245-11/581			
Remarks on Site / Site Conditions	\$ 100 miles			
1/30	11 (245-21) 587			
11.15	11 (34) -34) 638	./		
		<u> </u>		
Samples Relinquished by	Samples Received by	Comments		Date / Tine
2.7	7,			9-2135 515
Samples Relinguished/by	Samples (Received by	Comments	A CANADA DE LA CANADA DE LA CANADA CANADA CANADA DE LA CANADA DEL CANADA DE LA CANADA DEL CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DEL CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DEL CANADA DE LA CANADA DEL CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA CANADA DE LA	Date / Time
Samples Relinquished by	Samples Received by	Comments		Date / Time
Wence of Delivery			مستديد ، . حسب مستورست وسيد جيهن الأنظار وي مديد ۾ يشهر بندهيه	
		Seals Intacti	tacti Tres Inn	ıπ ⊡N.A.

finiginal and yellow copies to lak. Pink copy for project file, Lab forwards completed original copy to STS with unulytical results. Inb retains yellow copy. STS ENV 01 1-86

The state of the s

Samp	Samp	STS	STS
			l
			4

8/5	(i) of	111/1-1/21	# (101/1b	740
amples Shipped Via	amples Shipped From	amples Shipped To	TS Project Number	TS Project Manager
ō	ō	5	<u>–</u>	-

ο <u>ν</u>	Sealed for	ATTENTION		,	•
875	Cit of 5/10mi, 1/11/	1111 1211	A 13/0/26	Un't	

TINE () SC.		*** * *********************************	Record	
72.	ti		Custody	through
DATE			of	
And	1///	11/2	Chain	
6474	Sealed for Shipment by	ır(<u>1/2,</u>	Project Chain	Series
2	Sealed for	ATTENTION OF		•
	<u>_</u> ,			

	<u> </u>							<u> </u>	
	Labora- tory ID #						51.35.E	ln.e	N.A.
	Comments on Samples (preserved, etc.)					Date / Thie	1/22 /6 5/1 Bate / Time 9/23/88 5:36.00	Date / 1	
13	Comments								YES
Signa ture(s)	Number of Con- tainers								1-10-1-1
\	Analyses Required	1/4/1	Buch extestly ly weeken	Hold Hold	17911	Comments	Comments	Comments	Spole Intorti
Name of Sampler(s)	Analys	11011	Burre extra	11 OUZ	110116	Л вис	رمر		
Li	Sample Location	755 (7-1.0)	15-10 543	45-21) 955	4.8-31)552 MONE	est i	o by	5 1	
South Hall		613 (4.	20) 2/11	1518 (1957) 18196415	B13 (24,9	Samples Received by	Samples Received by	Samples Receive	
15 M. 1951	A Tailos at 20w Relica at 20w Relica at 20w A Tailos at 20w A Tailos at 20w A Tailos	><-			Conditions	3	Sol	los l	
Description	Maw gminotinom Naw gmitsixa			1 1	/ Site Co	λq	Jan Jan Jan Jan Jan Jan Jan Jan Jan Jan	Ьγ	
12	Dote Tu	12-6		1 1	On Site	Samples Relinquished by	Relinquished	Somples Relinquished by	or Delivery
Project Name	Sampling Point / Field 10 Number	13611 (1513 5113	1913.146	Rengriks	Somples R	Samples R	Samples R	alegnes of

Grighal and yellow copies to lab. Pink copy for project file. Lab forwards completed original copy to STS with analytical results, lab retains yellow copy. STS ENV or 1-86

temperate description of the company

<i>U</i> ;	S	0,	9)	0
			_	
	•	Á		4
h	- 5	·	_ ◀	4
K	ď			1
W.	And Park		2.	_4

Samples Shipped Via Samples Shipped From Samples Shipped To

DATE 7-22 81 TINE 15.50.	(c'11 115 fc		Custody Record	through
TE T	77 76		of	
Α <u>η</u> (1	11.6.67	Chain	
6475	-11-12 Sealed for Shipment by	NF	Project Chain	Series
å N	Sealed for	ATTENTINH D		
1 / C / C	Children Storter	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	ML 101.1.	740

Project Name / Description		Name of Sampler(s) / Mynature(s)	e(s) //
(12 5.1641. P.11	Chemis Soil swaping 5attle Melitas	~	
<u> </u>	(5)		
Sampling Date Time))e))t	Analyses Required Nur	Number Comments on Samples Labora- of (preserved, etc.) tory
Field	3A 3A	<u>ت</u>	
Number	onitorino xisting unface aste oil ther		toiners
17 741 1200	S >	-	
77-17 13674		11972 hold	
142 576.	15/2/4/5-6) 53.2.	110,4 19/1	
612 518	11265-11 533		
11/105.511	1,86		
1125	535		
111.64	15861		
Remarks on Site /	Site Conditions		
11/25/1	13/12	2915-31) 58.7 Razes Extertil 11/2/12/2	
14 1/1/19	16/2/245-30	100	
	,		
Samples Relinquished by	Samples Received by	Comments	Date / Ime
Ker Chillians	Cran)	\ \ \	13-75 1630
Sangles Relinquished By	Samples Received by	Coments	
Samples Relinquished by	Samples Rece	Comments	Date / Ime
Medus or Deuvery		Seals Intact	Ct: TYES THO N.A.
]

Griginal and yellow copies to lak. Pink copy for project file. Lak forwards completed original copy to STS with analytical results, lab retains yellow copy. STS ENV 01 1-86

<u> </u>
RFCHRI
~ .
با
>
<u> </u>
\vdash
CUSTONY
Ŀ
,
_
\triangleleft
\top
7
FIELD CHAIN
1
<u> </u>
ـــــــــــــــــــــــــــــــــــــــ
\
Z
\leq

—
\triangleleft
13
)
1.
11
1
Z
Lil
DE
, ,
ليا
=
<u>~</u>
\triangleleft
1 ^

S	S	S	S	C
17		7	_	
A	4	Á		
	-		المنت	4
P			43	*
(1)	A COMM			A

amples Shipped Via amples Shipped From amples Shipped To STS Project Manager TS Project Number

TIME CS (T) Record Custody through of Chain Sealed for Shipment by Project Series . 6477 ATTENTION OF 2

-Project Name / Des	Description		Nome of Completely / Cont	(1)
Ch. 18 16 16 11 1 10	henned Soil Sangles	Chemin Solsowite, Sullet Mily Tar	Personales (1)	
1	Sample Mype(s)	(5)		
Fount / Point / Fleid	wole woter	Sample Location	Analyses Required/	Number Comments on Samples Labora- of (preserved, etc.) tory Con-
Number	monitoring existing surface wastewa	nether	,	v
11 1881-6 15-21/1	128	1 (15/10-15) 55/	1/01/2011	
1115/12	35	755 (0-5:4) 5:15	11211 11011	
111/5/13	11/1	11/1/ (95-11) 553	1101/2/1/	
118 577	152	ALS (14.5-16) 554	Buren Expubilly Mobile	
12/18/5/18/	1202	2 ce (12-341) 2/3/	Ment holl	
1851	1210		Paren Fele 1616 July	7. Rolling to be
ON SIT	/ Site Conditions			
170.87	130	16K (245-31) 552	Mons holy	
11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1245	1 15M (345-36) 588	Mone holl	
:				
Samples Relinquished by	by	Samples Received by	Comments	Date / Time
Samples Relinguished by	by	Samples Received by	Comments	7-2566 /51/0
Samples Relinquished	ру	Samples Received by	Comments	Date / The
Heans of Delivery				
			Seals Inte	Seals Intacti [Mes [] Mil [] M.A.

finity of and yellow copies to tak. Pink copy for pruject file, tak forwards completed original copy to SIS with analytical results, tok retuins yellow cupy. 315 FHV 01 1-86

13.000		
	4	4
		1

amples Shipped To ... TS Project Number _ STS Project Manager _ amples Shipped Via ... amples Shipped From _

	"./K				
ST S	57 11 mis	Tak. 0011	di lefel il	17/16	

Record Custody through Sealed for Shipment by Mil Juliates of Choin ATTENTION OF 16.64 Project Series

rroject Rome / Description		Name of Sampler(s) / Signoture(s)	ture(s)		
Chock Sthuis Park , Chin	mia (con small south Miller	Dry Johnshi	11/0/1		
Sample	,	h			
Ja:	Sample Location	Analyses Required	Number Comments	Comments on Samples	Labora-
M G	os tūtį			rved, etc.)	tory ID #
au Bu			toiners		
tinom tinom)ios)ios		-		
	<u> </u>	11.11			
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		7,777			:
	-X-560,45-6,556	Made 1/2/11			-
144 543 1034	18 1861/95-11/583	non 11.13	701 Mil	/ 2 /	
160.544	1 15 (3/-74/1/12 X	Bushar VIntelliel	20/ 1/	3	
(N / 1/)			1-	-	
1.024	1	Most (1/4/1	111.01 6111		
850/ 7/87/	1981/2-37/199	Morry Melli			
Renarics on Site / Site Conditions	itions	1777			
LAS 4734	V K(1, 1995-21) 287	110.11			-
11131	1 KE 11	10.00			
				-	
- 1					
Somples Relinquished by	Samples Received by	Comments		Date / Time	
- 1	-			7591 9251-6	256
ramples relinguished by	Samples Received by	Comments		Date / Time	
				-	_
Samples Relinquished by	Samples Received by	Comments		Date / Time	
Means of Delivery		Cooler Tation	FO. 4.1		
		ニューロングロク	_	L N.A.	- -

üriginal and yellom copies to lak. Pink copy for project file. Lab forwards completed original copy to SIS with analytical results: Iab retains yellom copy.

:

.

directions between

Section 1

TIME (15 3 G		con control co					,					Date / Time	613-88 1056	Date / Time
Sealed for Shipment by $\frac{G293}{Ch}$ DATE $\frac{Q-1/3}{2h}$ $\frac{dP}{dA}$ TIME $\frac{(.5.3)}{2}$ $\frac{2}{2}$ ATTENTION OF $\frac{(.1.2)}{Ch}$ $\frac{(.1.2)}{A$	At	Comments on Samples (preserved, e·tc.)										Da	1/2	Da
t by U	Signo Aure(s)	Number of Con- tainers)						
No 6233 rated for Shipment TENTION OF Projec	Circle Complexes / Sign	Analyses Required	7		7/1)/ ₁	12/1		17	intille the Luck Less	,	Comments		Comments
A Se	Name of	Analy	71	16	77	97	Hi	7	Ho	Symmetry				
15 1 four Mills	atteffiely tu	Sample Location	125 /21-01/2	9 (4.5-6) 5521	4 (45-11) 453	9 (95-1/2) 555 9 (95-2)/ 555	4 (2454) 556		9 (245-31) 557	4 (345-36) 555 Symenof Whith the Landers		s Received by	Ninh	Samples Received by
600	fin fring		lios >	1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	1	7	1/2	701	7 7	\mathcal{G}	·	Samples	クク	Sample
Samples Shipped Via Samples Shipped From Samples Shipped To STS Project Number STS Project Manager	1111 1 121/14	SOTOWOT	SDA SDA Uns SIXa					Site Conditions						
Samples Samples STS Pr	Cuis Park (1)	Date Time	13-64 1400	1 1405	Ђон т —/-	2711	04.41	on Site /	74.7/	145-5	•	yd baysinbu	has ton	Rélinquished Apy
	Project Name	Sampling I Point / Field ID Number	115021	139511	24543	13 4 5.45	16 45 14	Remarks	18442	84569		Samples Relinquished		Samples Rall

Original and yellow copies to tak. Pink copy for project file. Lab forwards completed original copy to STS with analytical results. Tab retains yellow copy. STS EIV 01 1-86

N.A.

YES

Seals Intact: [

Date / Time

Comments

Samples Received by

Samples Relinquished by

Means of Delivery

ICATION / FIELD CHAIN OF CUSTODY RECORD IN State of Stronger 1 Str

1070 ---

235°44.44

Walter St.

IDENTIF]	Samples Shipped Vi Samples Shipped Fro Samples Shipped T STS Project Numbe
SAMPLE	

	Record			Labora tory ID #						:	; ;					
An analysis	of Custody through			Comments on Samples (preserved, e1c.)												
10 / 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1	ct Chain	Signa ture(s)		Number af Con-	tainers					7					_	
ATTENTION OF THE STATE OF THE S	Project	Name of Sampler(s) / Signa		Analyses Required			now Hald	11011 16/1	11012 Hild	1011 16/2	11011 1/0 //	11012 18/1		110119 [16/11	1014	
10 miles	100 July 100			Sample Location			188 (0-11) 511	18 (45-67) 81	18 (95-11) 63	[-/4]	13.8 (145-21) 555	18 1245-26) 456		08 Mr-31152	138 1345-36 1558	<u> </u>
			2		Jac		<u></u>			•			সূ		w.	
 E D	 		Type(s)	Folloz Folloz	aıs	105 805					- <u>·</u>		Conditions	T		
samples shipped from Samples Shipped To	STS Project Number STS Project Manager				TOWSTS	M U							미			
ped Ippe	Ž ₹		Sample	1910W	-face								ပိ			
dins Sh	Jec' lect	5	Sar	ness	gaite gaits						_		Site			
N O	S. S.	ıp tlı	-			-	1-1	.5)	·>	7	. 3	7	₩	0		
שם שיו משיו	SP	Description		Ime			104C	3/22/	1044	1201	,50)	711	`~	1126	13	
S	ST		_				1/2						Site	寸	$\overline{}$	
		a		Da te			4-11-51	_					등	_		
		Hame 1	*				7									ŕ
70		ect.		fing b	ē		1,7	S#2.	13	p 4	2	16	굯	Z	1	
		Project	†	Sampling Point / Field	1D Number		15 1	79	16.	3.5	15.7	7.5	Renarks	1/2	7	
re illi	12 10 mg	1	1	J, <u>—</u>			1	- ~	(===		1	5	R.	7		

lingnal and yelice copies to tak. Pink copy for project file. Lab forwards completed original copy to SIS with analytical results, lab retains yelion copy. STS EIN 01 1-86

4-13 45 1656 Date / Time

Date / Time

Comments

Comments

Bamples Received by

Samples Received by

Samples Relinquished by

Means of Delivery

Comments

N.A.

Seals Intacti (Tres

C

CUSTODY RECORI	Custody Record through		on Samples Labora.					•				Date / Time	Date / Time	Date / Time	N.A.
	7 1 +	Signoffice(s)	Number Comments on S of Cpreserved,	tainers					· · · · · · · · · · · · · · · · · · ·		,				Intact: TYES
CHAI	ATTENTION OF Property of the Seatest S	Name of Sampleries / S	Analyses Required		1/6 11 do 117	1/c// 40.1/	Toll nong	Me Hi Austr	1011 0011	LIP LIST NOW	######################################	Comments	Comments	Comments	Seals
ICALIUN / FIEL	9 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	mica heil Paring & South Phaly lan	Sample Location	osl/ Tarto	155 (1-0)/19 1	1 (4,0-0,522)	y >> (14.5-11) // 1/11	(1/2 2D 555	- 125 (12) - (12	- 10/1/24/5-1/ 552	() (11) (11) (13) 3 (3) () () () () () () () () () () () () ()	Samples Received by	Samples Received by	Samples Received by	
SAMPLE IDENIIFICA Samples Shipped Via	Samples STS Pro	Project Name / Description	Ing Date Time & Scaple well well water	N Lager on contorne existing existers wasters	11 ct/ d-51 Ke	1131 12-12 145 1111 1500 1500 1500 1500 1500 1500	7251 12-15 14/1/11	11 545 9-21 154/	a IS uo s	12.115114 9-21 16.02		Relinquished	Samples Rélinquished by	Sanples Relinquished by	Heans of Delivery

Original and yellow copies to tak. Pink copy for project file. Lab forwards completed original copy to STS with analytical results. Tab retains yellow copy.

152.63

CORI	тие Д <u>СЗС</u>	Record		Labora- tory	# G								Tine	5.75	Time	Tine
RE	- 1	ار		amples e (C.)									Date /	(5/7-1	Date /	Date / Time
CUSTODY RECORD	Seoled for Shipment by Control	in of Custody	1.00	Comments on Samples (preserved, e1c.)												
	t by [12]	sct Chain	Signa ture(s)	Number	Con- tainers							<u> </u>	-			
/ FIELD CHAIN OF	No 6472. Led for Shipnen	Project Series	Rangler(s) / Sign	Analyses Required		th. 13							Comments		Comments	Comments
	Seo A		Name of Sc	Analysi		1/01/					+	*				
z	5+5 Chyt 51 Maighar	74019 B	South Hely tw	Sample Location		811/0-15-1551	1511 (4,15-6) 55 L	1/1/2/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1	11/ (125-20)5815	101/ (410-11) /10	11 (245-71) 567	11/2(35 1:15) //10	Samples Received by	16 mg 11/1. 1/4/		Samples Received by
FICA	From d To	mber	Pering S	Type (s)	wastewate soil					Conditions		 	2		9	Sam
IDENTIFICATIO	Samples Shipped Via Samples Shipped From Samples Shipped To	STS Project Number STS Project Manager	Description	Jato Jet Di	w appluns	(0.83)	1636	15.5	1058	/ Site	05.11		ed by	-11	/a/pa	d by
SAMPLE			t Name /	ng Date		1 92168 1053			·	Ks on Site			s Relinquished by	11/1/2/201	s keinquishe	Samples Relinquished by
SAN		R	Projec	Sampling Point /	riela ID Number	1119	25 75 25 15 25 25 15 25 25 25 25 25 25 25 25 25 25 25 25 25	75 11:		Renarks		1. 1. 1/1.	Samples	~ h #//	sample:	Sample

finitinal and yellow copies to tak. Pink copy for project file. Lab forwards completed original copy to STS with unalytical results. Tub retuins yellow copy. STS EIV. 01 1-86

Means of Delivery

N.A.

Seals Intacti Tres

The state of the s

S	S	S	S	V
1	4	7	_	
200	E	A		
			- T	A
	8			A
(6			K	ď

_	<i>) (</i> :	> ⊲	:		
878	Cit of 5/18": 1/4/	110 001	H13/0/26	4.7	

CHAIN OF CUSTODY RECORD	Sealed for Shipment by Constant of Custody Record String Record Series through
/ FIELD CHA]	Sealed for Shipmer
SAMPLE IDENTIFICATION	Samples Shipped Via Samples Shipped From Samples Shipped To STS Project Number
SAMPLE	

	Name of Sampler(s) / Signaturp(s)	/ / (5)	
Ch. 2 4 Spin Pork / Chemin Soil Son Mi Soul 13+ Wally tou	1 124 Just 1.		
Sample Type(s)			ĺ
Sample Date Time E Location	Analyses Required Num	Number Comments on Samples Labora-	ij
MG;			
22 23	tail	sus	
onitc Sistema Sistema Josephan	,	-	
S			-
18 (3-1-87) (1-22 X X X 15-15) 55/1	1/9/7 - John		
1:13 (4)	177 0000		
	377777777777777777777777777777777777777		1
0.0557.1-2.1.0.1.5.1.0.1.5.1.0.1.5.1.0.2.5.2.	Michoe Chathly ly 1,60 to 1		Ī
1213 5111 -16 584	1 1000 1/2/2		
15/15/16	7		
	/		
	11042 1106		
Remarks on Site / Site Conditions			ł
13.13 H. 1.13 (24,8-31) 567 (1000)	1/77		
	9		i
11.15/18 11.15 (3.11 - 36) 538	1) CIAL ENK!		1
		::	
Spaples Received by	Comments	Date / The	
(2) 100 / (2)	ma	08.91 77.6	-
Samples Relinquished by	Comments	Date / Time	!
(1) (1) (1) (1) (1) (1) (1) (1) (1) (1)		9/25:35 38/cc/8	-5
Samples Relinquished by	Comments	Date / Time	- :
Heans of Delivery	1 - 10		Ï
			-

finitional and yellow copies to tak. Pink copy for project file. Lab forwards completed original cupy to STS with analytical results. Init retains yellow copy. STS file of 1-86

Mary 1998 September 1997 Commenced September 1997

	y	
A.	- सम्ब	

i i	1	- * * * * * * * * * * * * * * * * * * *	.	
Samples Shipped Via	Samples Shipped From	Samples Shipped To	SIS Project Number	STS Project Manager

1 TIME 15.50	, ke	, . :	Record	
DATE 9-22-81 1	124115	:	Custody	through _
75 31	1) #1		of	
) DA	1/6	11.6.00	Chain	
, Nº 6475	- Il-/ Sealed for Shipment by	ATTENTION OF	Project Chain	Series
10 -11-11-11-11-11-11-11-11-11-11-11-11-11	in the City of Syla-Lieup	0 - feeth poly		er
Ś	ē	ř.	Jac	e e

1.12 & 3.1 Pruis P.11"	(hemin) 50	Someting Sattle Meilton	Control of Sampleries / Signatureis	Threes		
_	Sample Type	<u>, </u>				
Sampling Date Time Point / Fleid	well water	Sample Location	Analyses Required	Number Comment of Cprese Con-	Comments on Samples Lab (preserved, etc.)	.abora- tory ID #
JB Number	wastewa surface existing existing existing	nerner Tehtro		toiners		:
125419-22		1 12 C-17 551	hare hall			
15 5% IN		755 (7-57) 215				
612.528		112/2,5-11) 533				
1812.5MI						
112 CH		535		,		
		1/1/1/	l			1
ks on Site /	Site Conditions	۔ ب ب				
1016.64		1312 (29,5-31) 55.7	295-31) 55.7 Burea Extrable 1/30 1000		-	
612418 V		4 612 (345-24) Sig	Jul 1196			
Samples Relinquished by	`	Samples Received by	Comments		Date / Ime	
		JAN YON	(m)		•	- ت
	Silan	Sangles Received by	Comments	·	1/33/88 :53	3.00
Samples Relinguished by		Samples Received by	Comments		Date / Time	
Money of Dolly	-			. M. (L. L. Q. L. Q. L. M. A. L. L. L. Q. L. Q. L. M. A. L. L. L. L. L. L. L. L. L. L. L. L. L.		
ל זאטואט זט פוויאי.			Seals In	Seals Intact: Tres	[_]ND [_]N.A.	· _

Original and yellow copies to lak. Pink copy for project file. Lak forwards completed original copy to SIS with analytical results. Inia retains yellow copy. SIS ENV 011-86

OF CUSTODY RECORD

Khim rows

Barney , the

derme a Off

700 m

変

TIME (C)

DATE 2-23

Record

Custody through

of

Chain

Pro*jec*t

Series

upment by

Signa taye(s)

Labora-tory [D #

Comments on Samples (preserved, e1C.)

Number of Con-tainers

Samples Relinquished by	Samples Received by	Comments	Date / Time
Samples Relinquished by	Samples Received by	Comments	1 2 2 4 / 21/0
Samples Relinquished by	Somples Received by	Comments	Date / Time
Hears of Delivery		Seals Intact: TYES THI THA.	in N.A.

855 (36-345)

X15 VV

6K (245-3) 552

Grighest and yellow copies to tak. Pink copy for project file. Lak forwands completed original copy to STS with analytical results. Tak retains yellow copy to STS with analytical results. Tak retains yellow copy STS RIV 01-1-86

** -- * 1

Sar	Sar	Sal	STS	L
7	-	7		1
	-	4	• • • • • • • • • • • • • • • • • • •	A
K	9		P	4

Samples Shipped Via City of Stamples Shipped From City of Stamples Shipped To Think to STS Project Number Think STS Project Manager

Sealed for Shipment by Childing ATTENTION OF Series

TIME 1500

Record

Custody through

Project Name / Description	li .	Name of Sampler(s) / Signature(s)	
City of illowed Illiam Is Sectional	In soft of Colotor		
Sample Typ	(5)	W. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	
Ten	Sample Location	Analyses Required Number	Comments on Samples 1.c
Jag DA Iam	os	Con-	
GMD Build COPI		tainers	Ŋ.
LSOM Juns SIXA	auto soll	-	
151-1511 9-2388 0752	1 134(c-j.s) 55 /	1 11.11 4000	
07.0	1 6/4/45-6> 552.	11911/1/1/	
11/15/13 CN:25/		1/4/2011	
2180 1/4 8/1/4	1/4 (145-4) 55 4	1902 11/1	
11/45/5	13/4 (45-21) 555	Berrand Folia tible Machan	
<u>ا</u> ن	11/4 (275-22) 556	11011 hall	
Rengrics on Site 62 Site Conditions	17/1/ (25.5-1	Many hold	
14.75		1 Wall Steph	
5,7,5473	ı	Lieuze bill	
13.15HIF V 6435	1/55//	* (1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	
Samples Relinquished by		Comments	Date / Time
16-15 Musi 64	Lebellahr		17-23 48 15-10
Samples Relinquished by	Samples Received by	Comments	hate / Time
Samples Relinquished by	Samples Received by	Comments	Dote / Time
Means of Delivery		Seals Intact: Tres	tı YES NI
			· — ·

Original and yellow copies to lak. Pink copy for project file. Lab forwards completed original capy to STS with analytical results, lub retains yellow copy. STS ENV 01 1-86